NORTH DAKOTA REFUGES

NARRATIVE REPORTS
OF
JOHN H. STEENIS

OCTOBER 1937 - OCTOBER 1938

Quarterly Narrative Report
August 1 to October 31, 1938

Introduction.

Most of the last quarter has been spent in finishing up field work prior to my transfer from Des Lacs Refuge to Seney Refuge.

After being transferred to the Seney Refuge I spent time in getting acquainted with the nature of biological development and aspects on this refuge. Unless otherwise requested, I do not intend to write an individual narrative report but will contribute to the quarterly narrative report for the Seney Refuge.

Cover Type Mapping--Des Lacs Refuge.

As explained in previous reports, cover type mapping was not carried on on other refuges, with the exception of the Des Lacs Refuge, because of lack of suitable personnel for doing this work. Later in the fall it is very probable that Mr. Hammond will continue the mapping work at the Lower Souris Refuge.

At the Des Lacs Refuge considerable time has been spent on checking and doing cover type mapping with a CCC enrollee, V. G. Krebsback, who has been doing an acceptable piece of work. However, after checking cover type maps, it became evident that regular checks on Krebsback's work are necessary so as to correct occasional faulty slip-ups. Further, Krebsback is not well enough acquainted with marsh plants to map the complex mixture of marsh plants found in pond-site 7 and 7a.

Cover types used in this mapping were broad, with specific information

about individual types explained in notes. (See enclosed sample maps and notes.)

Botulism.

Outbreaks of botulism have occurred in Des Lacs, Upper Souris, and Medicine Lake Refuges. Lower Souris, Arrowwood, and Lostwood Refuges were bothered with botulism.

Des Lacs Refuge: The drying up of the lower part of the Upper Des Lacs Lake has cut down the ravages of this disease to a large extent. Pond-sites 3, 4, and 5 had slight attacks.

Upper Souris Refuge: Slight attacks of botulism occurred near the dam in Lake Darling. It was interesting to note that only a few dead birds were found in the upper reaches of ~~this reservoir lake~~ Lake Darling where there are dense beds of swamp smartweed. (Polygonum muhlenbergii.)

Medicine Lake Refuge: At Medicine Lake botulism continued to be one of the most serious outbreaks that have occurred in this district. The significance of an intensive marsh and aquatic planting program with reference to botulism has been discussed in previous reports. It is probable that there will be sufficient concentration of toxin to cause outbreaks of botulism next spring.

Biological Improvement Work.

After a conference and field trip with Mr. Dougall a biological improvement program was drawn up for the Upper Souris Refuge.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

VEGETATION TYPE MAP

Refuge Des Lacs State North Dakota County Burke

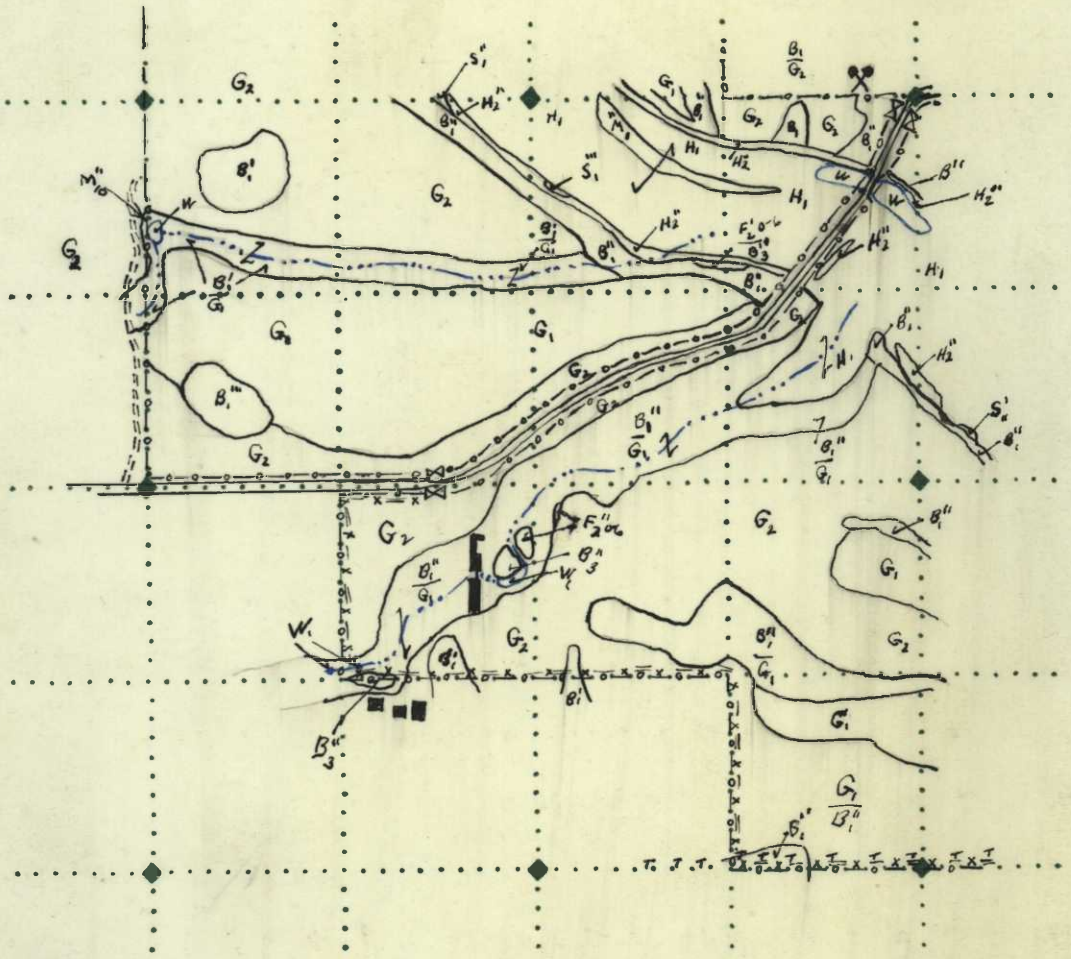
Mapper ..... T. 164 N R. 89 W Sec. 34

Date 7/8/38 Checked by .....

GPO 8—10815

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	[redacted]	35	36

TOWNSHIP DIAGRAM



NOTES FROM COVERTYPE MAPPING
Twp. 164 N., R. 88W., Sec. 34

H_1 Old lake bottom covered with weeds; marsh elder (Iva xanthifolia) foxtail (Hordeum jubatum) burdock (Rumex sp.) russian thistle (Salsola kali) and canadian thistle (Cirsium arvense L.) some pale smartweed (Polyginum lapathifolium).

H_2 Sweet clover (Miliotus officinalis).

G_1 Prairie needle grass (Agrostichae stipa) and wheat grass (Agropyron smithii) and other ~~weeds~~ grasses.

G_2 Short gamma grass (Bouteloua oligostachya) dominant some sage (Artemesia Sp.) and prairie needle grass (Agrostichae stipa).

B_1 Buckbrush (Symphoricarpos occidentalis) some silverberry (Elaeagnus argentea) very little rose (Rosa sp.)

B_3 Thorn apple (Crataegus sp.) dominant some chokecherry (Prunus virginiana).

S_1 Willow (Salix sp.) mostly dead.

F_2 Quaking aspen (Populus tremuloides).

M_1 Hard stem bulrush (Scirpus acutus) dominant some ameridan bulrush (Scirpus americanus) and prairie bulrush (Scirpus paludosus).

M_{10} Spiked rush (Eleocharis palustris).

W_1 Sago pondweed (Potamogeton pectinatus) dominant, water crowfoot (Ranunculus longirostris) water starwart (Callitriche autumnalis) water mylfoil (Myriophyllum spicatum) also needle rush (Eleocharis acicularis).

NOTES FROM QUARTER MAPPING

Twp. 164 N., R. 88W., Sec. 34

H_4 Old Lake bottom covered with weeds; marsh elder (Iva xanthifolia) foxtail (Hordeum jubatum) burdock (Rumex sp.) russian thistle (Salsola kali) and canadian thistle (Cirsium arvense L.) some pale smartweed (Polygonum lapathifolium).

H_5 Sweet clover (Melilotus officinalis).

G_4 Prairie needle grass (Aristiglhae stipa) and wheat grass (Agropyron smithii) and other weeds.

G_2 Short grama grass (Bouteloua oligostachya) dominant some sage (Artemesia Sp.) and prairie needle grass (Aristiglhae stipa).

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Extra copy of narrative report for Mr Kubichek

ANNUAL REPORT

FISCAL YEAR

1938

John H. Steenis
Ass't Refuge Manager

INDEX

The underlined needs your consideration

ANNUAL REPORT

FISCAL YEAR

1953

John H. Steenis
Ass't Refuge Manager

Aleutian Expedition

During the early part of this past fiscal year, I was a member of the Aleutian Island Expedition, Mr. O.J. Murie being chief of party.

While on the Aleutian Expedition, it was agreed that Murie would work up the report. Each one of our party was to work on a contribution to this report dealing with some phase of the field work. Mr. Douglas Gray, of the Alaskan Game Commission, contributed information on human relations with reference to future administration. MR. Murie's problem, aside from completing the report, was birds and animal life. Dr. V. Scheffer contributed on marine and invertebrate life with particular reference to food habits. My problem dwelt with the vegetation.

During the the expedition we collected specimens and gathered data on all phases of the work and were continuously involved in roundhouse discussions on various problems. Information and collections on different phases of the job have been turned over to the person working up this phase of the work.

In February my contribution to the Aleutian report Flora of the Aleutian Islands with vegetative covertype maps made on parts of two of the islands was turned in.

In June a complete report on the Aleutian plant collection was received from the Washington office. During the latter part of June I had a conference with Mr. Murie. He suggested that it would

not be necessary to add further notes on plant distribution because Dr. Eric Hulten's recent paper Flora of the Aleutians was a comprehensive report. Further Hulten was at Washington and checked over our Aleutian plant collection. As a consequence, no effort will be made to further contribute notes on plant distribution unless a further request is made.

Unfinished work still left to be done is the identification and labeling of a seed and fruit collection and the catalogueing and labeling of negatives and photographs.

North Dakota Refuges and Medicine Lake Refuge, Montana

Upon returning from the Aleutians, my instructions were to act in an advisory capacity and also be held responsible for the different biological problems and aspects of refuges in North Dakota and Medicine Lake, Montana.

Detailed reports on various projects mentioned in this report are found in my monthly narrative reports from September to June of the past fiscal year. Tabulations made in this report were received from refuge managers.

Wildlife

The essential projects of developing and maintaining these refuges for wildlife does not leave much time or labor for studying various wildlife conditions by the refuge personnel.

On the Lower Souris Refuge, Mr. C. J. Henry, refuge manager, has been privileged to have several fine field men working on his refuge. As a result of Henry's own field work and of the splendid manner in which he took advantage of the field work that others had done on this refuge, it is possible to help out and apply this biological work to other refuges.

Cover Type Mapping: In the winter and spring of 1937, a determined effort was made at the Washington Office to present an effective system of mapping to aid in preserving a record of the original plant ecology and show the desirability of different types of cover from the standpoint of wildlife use.

Cover type mapping was started on the Lower Souris Refuge by Mr. Jenson, Student biologist, and later carried on by Mr. Hammond, biological aid. On the basis of the mapping done on this refuge, a standardized system of cover mapping was outlined that could be used on North Dakota refuges and Medicine Lake Refuge, Montana.

During last fall mapping was started with the Junior Assistant to Technician on the Upper Souris, Des Lacs and Arrowwood Refuges. It appeared that everything was set for having a flying start the next spring. As is probably known this was not the case on any of the refuges. Since supervisory staff of the CCC camps were out, it was considered necessary to use Junior Assistant to Technicians in a supervisory capacity. As a consequence not much time has been spent on mapping. Efforts to use CCC enrollees has not been successful with the exception of Mr. V. C. Kredsback, enrollee, Company 797, Des Lacs Refuge. Kredsback has proven himself to be a well qualified mapper. Attempts to get student biologists have resulted in the appointment of Mr. Stotler as student biologist on the Des Lacs Refuge. He is doing cover type mapping and progressing nicely. No other student biologists have been appointed in this district as yet.

Progress made on cover type mapping follows:

Refuge	Approximate number of sections mapped
Arrowwood	9
Lower Souris	26
Upper Souris	10
Des Lacs	12

During April and May the desirability of having a systematic basic knowledge on bird, animal, and plant life was discussed with

different refuge managers. As a result of these discussions a proposed program on the preparation of check lists was drawn up. The importance of tabulating these field observations in the form of a systematic check list is self explanatory. Check lists would furnish basic knowledge helpful in formulating biological policy on the refuges. Furthermore, it was hoped that the tabulating of such information exchanged between refuges would collectively aid in building up a better understanding of wild life conditions on the refuges. The building up of check lists would furnish systematic presentation of wild life data requested in the memorandum on Preparation of Refuge Narrative Reports. So far no attempt has been made to do this work with refuge managers since a request has been made that these plans for making out check lists be withheld.

Waterfowl Census: Attempts have been made to have census on or about the 25th of each month and to some extent at other times too. Such field data tends to furnish desired information on the productivty of the refuges. Because of the luxuriant growth of marsh vegetation, census work has been confined to estimates. Recent estimates on waterfowl census follows:

Refuge	Number of birds
Arrowwood	2,200
Lower Souris	27,000(o ver)
Upper Souris	28,000
Des Lacs	10,000
Lostwood	2,000
Medicine Lake	22, 780

These estimates are for ducks, coots, and grebes on Des Lacs and Lostwood refuges and for ducks and coots on the other refuges. For the more specific details on census see the reports of individual refuge managers.

Nesting Studies: At Lower Souris Refuge, Mr. E.R. Kalmbach's intensive nesting studies will furnish desirable information on productivity of breeding ducks and also necessary information on predators, nesting concentrations, and nesting cover that will be valuable for other refuges. Refuge personnel have been carrying on nesting studies to a limited extent on other refuges.

Bird Banding: Bird banding has been done to a certain extent on all refuges. Considerable banding has been done at the Des Lacs and Lower Souris Refuges.

Botulism: During the past winter an effort has been made to gather all information relative to the Botulistic outbreak on the Des Lacs Refuge with reference to trying to figure out some means of control. Various means of control were discussed. A proposed impounding of water in coulees for the purpose of flushing was suggested. After having further conference with Mr. Mc Bride and Mr. Kalmbach it appeared that such a plan would not be feaseable. Exactly how to handle the botulism problem in Upper Des Lacs Lake remains a problem.

Further field observation and study tends to show that Botulism can be a serious problem in recently flooded areas where there is a drop in water level particularly during July and August. It also appears quite obvious that if there is a luxuriant growth of marsh and aquatic plants, Botulism outbreaks will not occur or will not be so serious. These tentative conclusions are based on conditions of pondsites of the Des Lacs, Upper Souris, and Medicine Lake refuges.

A better understanding of how marsh and aquatic plants

might effect the causitive organism can be had by knowing certain significant facts. The bacteria Clostridium botulinum, type C. secretes a virulent toxin that kills ducks when sufficiently concentrated. Ideal conditions for rapid toxin concentration occurs between 82.4° F. to 98° F. This bacteria is an anaerobe and consequently can not exist in the presence of free oxygen. On the other hand aquatic chlorophyll bearing plants produce free oxygen by their photosynthetic processes and consequently appear to cause a non- desirable environment for anaerobic life. In other words the presence of green aquatic plants tends to purify the water so that a serious botulistic condition will not develope.

Marsh vegetation such as rush and smartweed also tend to play an important part since they cover marginal mud flats and prevent roiled water due to wave action. Furthermore, marsh plants would shade water filmed mud flats and shallow water areas and thus tend to prevent high temperatures so desired for secretion of toxin.

The algaes tend to produce an oxygenated condition like the macroscopic plants, but unfortunately much of the algaes become senile and later begin to decay during the heat of the summer and thus directly or indirectly appear to form suitable media for the botulism organism. It is possible that the above has happened on the refuges, particularly in the Upper Des Lacs Lake. It appears safe to conclude that more intensive marsh and aquatic planting will do much to correct unfavorable botulistic conditions.

Upland Game Birds: Observations on upland game birds seem to indicate that they are doing very nicely. Native game birds, the sharptail grouse and the prairie chicken, in particular are increasing. The birds came through the winter very well because of mild weather and ample natural feed. Mr. Hammond, biologist at the Lower Souris Refuge, made an interesting study of upland game birds. Conclusions from his studies are very worthwhile and should furnish valuable information for personnel on other refuges.

Predators: Results of predator control on the various refuges is shown on the following chart.

	Arrowwood Refuge	Lower Souris Refuge	Upper Souris Refuge	Des Lacs Refuge	Lostwood Refuge	Medicine Lake
Common Rat		18				
Weasel	[illegible]	203	113	63	5	57
Mink	1	17	6			
Skunk	4	186	77	12	1	67
Red Fox		28	5			
Coyote		5	9	6	7	7
House Cat		5	12	5		30

Refuge Developement

Projects on refuge developement have been studied on all refuges and where necessary have been drawn up after field trips and conferences with refuge managers.

Structural Improvements: Biological aspects of structural improvements were checked over. No amendments or changes seemed necessary for the Arrowwood, Lower Souris, and Medicine Lake refuges. Detailed reports were prepared explaining the desirability of having coulee dams and ditches in pondsites for creating islands on the Upper Souris and Des Lacs refuges. Similar reports on the building of dams and building up of low water islands on the Lostwood Refuge were prepared. To date the following work has been done on these projects. Ditching in pondsite #1 has been started at Upper Souris Refuge and partly completed. On the Des Lacs Refuge projects for building three coulee dams have been approved and started. The projects on building coulee dams on Upper Souris Refuge, ditching at Des Lacs Refuge, and raising low water islands on Lostwood Refuge were not approved.

Habitat Improvements: On the Upper Souris Refuge a habitat improvement program was carried out. During the winter fish shelters, fish spawning rafts, upland bird lean-to-shelters, upland bird brush shelters, and rail fences were built. Large islands were improved by graveling. On the Des Lacs Refuge the construction of upland game bird shelters was completed.

Farming: The farming program for refuges in North Dakota and Medicine Lake, Montana, is shown on the following chart.

Farming Program

	Arrowwood Refuge	Lower Souris Refuge	Upper Souris Refuge	Des Lacs Refuge	Lostwood Refuge	Medicine Lake
Wheat	55A Good	127A Good				114A Good
Barley	95A Good	164A Good	180A Good	100A Good		89A Good
Fall Rye		67A Good				50A Good
Millet	8 A Good	15A Good				35A Good
Amber Cane	5A Good	10A Good				
Sudan Grass	2A Good					
Kaffir Corn						6A Good
Flint Corn	36A Good	85A Good	80A Good	160A		116A Good
Sunflower						5A Good
Soy Bean						9.5 A No Results
Buckwheat						9.5 A Good
Share Crops		1200A	40A	100A		275A

Tree and Shrub Planting: Projects on tree and shrub planting were worked up with refuge personnel and carried out to some extent. The large and extensive tree and shrub program as outlined by the Washington office proved to be a correspondingly large task in the field. Tree and shrub planting for refuges in North Dakota and Medicine Lake, Montana, is shown on the following chart.

Tree and Shrub Planting

	Arrowwood Refuge	Lower Souris Refuge	Upper Souris Refuge	Des Lacs Refuge	Lostwood Refuge	Medicine Lake
Green Ash	40,000	815	1,967	2,000	2,000	25,000
Hackberry	2,000					
American Elm	2,000	290	42			20,000
Chinese Elm		140	3,549	5,000	6,000	5,000
Rose		75	76			
Woodbine		50				
Caragana	25,000	450	1,653	3,000	3,000	8,000
Tartarian Honeysuckle		100				
Red-Osier Dogwood	1,200	100	39			
Box Elder		500	77		2,000	1,700
Aspen		775	1162			
Cotton-wood		300		2,000	3,000	3,500
Thornapple			11			
Juneberry		250	337	500		500
Chokecherry	42,000	200		2,000		
Silverberry		167	37			
Russian Olive	350					15,000
Other Trees and Shrubs			22,000			
Willow					1,500	

M Marsh and Aquatic Planting: Little need be added about the importance of marsh and aquatic planting for food and cover. However, the Necessity of hurrying and guiding Nature in getting marsh and aquatic plants growing in pondsites is of vital importance in order to have healthy habitats for waterfowl. Though most of the marsh plantings have been completed, the aquatic stem planting has been neglected on several of the refuges because CCC camps were leaving orsupposed to be leaving.

Marsh and Aquatic Planting on North Dakota Refuges and Medicine Lake

	Arrowwood Refuge	Lower Souris Refuge	Upper Souris Refuge	Des Lacs Refuge	Lostwood Refuge	Medicine Lake
Pondweed* (Potamogeton)			Stem Planting			50 lb. seed 5000 Tubers
Cord grass (Spartina michauxiana)				12 truck loads of root stock		
Wild Rice (Zizania aquatica)	100lb. Seed No Success	400 to 500 lbs. Seed Fair Success	8 sacks Seed Fair Success	3 handfuls Seed Good Success		
Wild Millet (Echinochloa crusgalli)	500lb. Seed		1000 lb. Seed			500 lb. Seed
Hardstem Bulrush (Scirpus acutus)			41 truck loads Rootstocks	40 truck loads Rootstocks		2000 Plants
Prairie Bulrush (Scirpus pallidosus)				4000 lbs. Tubers		500 lbs. Seed
Swamp Smartweed (Polygonum muhlenbergii)						100 lbs. Seed 5000 Plants

* Mostly P. pectinatus

Respectfully submitted,
July 30, 1938

John H. Steenis

John H. Steenis
Ass't. Refuge Manager

Extra copy of Annual
Narrative Report for
Mr Kubichek

8/26/38

QUARTERLY NARRATIVE REPORT

May 1, 1938 to July 31, 1938

9-13-38

REG

Introduction

Much of the work done during this quarter has already been discussed in the monthly narrative report for May and in the annual narrative report. Just the phases of the work which have received most attention since the annual report was sent in, are mentioned in this report.

Cover Type Mapping

The progress made on cover type mapping was explained in the annual report. The Des Lacs Refuge is the only area where cover mapping is being carried on at the present time.

During July, Mr. Donald Stotler, Cornell College, Iowa, was assigned to the Des Lacs Refuge as a student biologist. Considerable time was spent in the field acquainting Mr. Stotler with the cover type mapping. He has been spending two to three days a week on mapping. Mr, V.C. Kedsback, enrollee, CO. 797 has been helping in this work.

Plant collecting has been correlated with mapping and will help to give a better understanding of the vegetative cover types.

Census, Bird Banding, and Nesting Studies

The nature of work done on the North Dakota refuges on census, bird banding, and nesting studies are mentioned in the annual report.

Botulism

During the month of July there occurred outbreaks of botulism on the Upper Souris, Des Lacs, and Medicine Lake refuges.

In these affected areas, dead birds have been buried and sick birds treated with water and banded.

Careful field observations have been made for comparing botulism on refuges in North Dakota and Medicine Lake, Montana. From these studies certain conditions that seemed favorable for botulism and other conditions that seemed unfavoralbe for botulism have been observed. Comparison of these studies with studies made in the past seasons on these refuges, tend to show certain facts in regard to possible means of control.

Botulism on Des Lacs Refuge--Upper Des Lacs Lake:

Upper Des Lacs Lake has been bothered with botulism to a limited extent this year. A sample of the plankton found in this lake was sent to Prof, C. Juday, of the Wisconsin Natural History Survey. He stated the "plankton sample has a great variety of forms in it, chiefly , Pediastrum, Scenedesmus, Chroococcus cells apparently Oscillatoria filaments, Oocystis, etc. Most of the organisms appear to be greens and diatoms." Juday also stated that it appears feasable that these plankton upon becoming senile and decaying will deplete the oxygen in the water and furnish suitable media for the Clostridium botulinum organism.

However, if this plankton remained active through the hot weather period it would probably tend to oxidize the water and not cause a favorable botulistic condition. This has been shown in the

upper reaches of the Upper Des Lacs Lake where no botulism has been found and the plankton apparently remains active during the hot summer months. Thus plankton appears to work two ways in regard to botulstic ? conditions.

In infected areas treatment of the lake with copper sulphate for the purpose of destroying plankton might be a worthy experiment. Lakes have been treated on a commercial scale with copper sulphate in order to prevent blue greens and other algaes from becoming obnoxious. Mr. Kalmbach once suggested that this treatment might be a worthwhile experiment.

As previously stated attempts to introduce marsh and aquatic pl ants have not been successful on this upper lake.

The outbreak of botulism on this lake has been small this year because the lake is nearly dry.

Botulism in pondsites on the Des Lacs Refuge: The extensive marsh planting particularly of bulrushes has been very effective in preventing roiled water conditions and consequently waterplants were able to grow and spread rapidly. Here botulism has been dropping off during the past three years. Only a few dead birds were found in these pondsites during the outbreak this season. It appears that marsh and aquatic vegetation offer a balanced biological condition not suitable for botulism. Possibly marsh vegetation, shading water filmed mud flats and shallow water areas, might help prevent the high temperatures suitable for a botulism environment. It also seems probable that the

oxygenation of water due to photosynthesis of plants is an aid in preventing an anaerobic condition necessary for botulism.

Further flooding of pondsites #3,6,and 8, is contemplated if there is sufficient water next spring. It might be advisable to burn over and plow these areas this fall in order to prevent an accumulation of organic matter which might furnish suitable media for botulism.

Another possible control method for some of the pondsites on the Des Lacs Refuge would be to impound sufficient water in the middle Des Lacs Lake so that a constant water level can be held in pondsites #2, 5, and 6. The significance of a constant water level has been shown on the pondsites of Upper Souris Refuge.

Botulism on Upper Souris Refuge--Lake Darling: Fluctuating water levels and lack of vegetation appear to have resulted in a suitable environment for botulism in front of the dam in Lake Darling. Here it is certain that sources for botulism are in the immediate vicinity of the dam, because birds in the molt that were unable to fly have been picked up stricken with botulism. On the upper reaches of Lake Darling that are covered in part or wholly with swamp smartweed(Polygonum muhlenbergii) there has been no trace of botulism. Here again the importance of plant vegetation has shown itself.

Botulism in pondsites--Upper Souris Refuge: It is quite possible that extensive beds of swamp smartweed have played a vital part in preventing botulism in the recently flooded pondsite #41 which is subjected to fluctuating water levels.

The lower pondsites on Upper Souris Refuge which have a constant

water level and a correspondingly luxuriant plant growth have not been infected.

Botulism on Medicine Lake Refuge: A severe outbreak of botulism on the Medicine Lake Refuge has occurred particularly on the newly flooded areas where the water level has dropped. About 15,000 birds have died this season. There is a lack of marsh and aquatic vegetation on much of the Medicine Lake Refuge. In view of the fact that the presence of marsh and aquatic plants appear to have played an important part in controlling botulism on Des Lacs and Upper Souris refuges, it seems advisable to carry on extensive planting of such plants on this area.

- On the Homestead unit, a constant water level held during the hot summer months should be effective in controlling botulism.

Refuge Developement

Various phases of refuge developement carried on during this quarter were discussed in the annual report.

John H. Steenis

John H. Steenis

Assistant Refuge Manager

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Refuge Developement

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John H. Steenis
John H. Steenis
Assistant Refuge Manager

NARRATIVE REPORT OF ACTIVITIES
MAY, 1938

Cover Type Mapping: In the winter and spring of 1937, a determined effort was made at the Washington Office to present an effective system of mapping to preserve a record of the original plant ecology and show the desirability of different types of cover from the standpoint of wildlife use.

At the Lower Souris Refuge, Mr. Jenson and Mr. Hammond were the only men to do cover type mapping during the summer.

On my return from Alaska, Mr. Salyer's letter of September 30, 1937 to Mr. Maurek, with reference to my status, explained that I "will also confer with refuge managers and direct them in connection with the type mapping surveys of the respective areas".

In Mr. Maurek's letter to me of October 3, 1937, he stressed the importance of properly training men for this job and suggested that the Junior Assistant to Technician should be used. Mr. Maurek also stated, "The work cannot be carried on to advantage after the snow, but I feel if work and training are started this fall it will enable you to start off in good order next spring."

Accordingly the cover type mapping at Lower Souris was thoroughly studied and checked over and a standardized system of mapping was effected that could be used in refuges of this district.

Junior Assistants to Technician in CCC Camp at Upper Souris, Des Lacs, and Arrowood Refuges were carefully trained for doing cover type mapping and satisfactory progress was being made. It appeared that everything was set for having a flying start this spring.

As is probably known this was not the case on any of the refuges. Since supervisory staff of the CCC Camp is being cut it has been considered necessary to use Junior Assistant to Technician in a supervisory capacity. As a consequence not much time has been spent on mapping. In fact at the present time no cover type mapping is being done on any of the refuges in this district. Further, I have been orally informed that Junior Assistants to Technicians will be dropped from the CCC staff on July 1st.

An attempt to get the Junior Assistant to Technician transferred from the Arrowood Refuge CCC Camp that was about to be broken up to the CCC Camp at Medicine Lake was of no avail. This was to be regretted since the use of aerial survey maps made in that part of Montana that included Medicine Lake Refuge would have made it possible to have very accurate precise cover maps that would certainly be a very valuable piece of work.

Attempts to get CCC student biologists for mapping appeared to be unsuccessful because such men are not carried under the CCC.

Efforts to use CCC enrollees are not successful unless they are working with a well qualified mapper.

RCG

WEH 7-1-38

Mr. Maurek's Circular letter of April 26, 1938, explaining that a student biologist position would be paid $40 per month as accepted under Civil Service regulations and would be given Secretary appointment etc., was not sent to me. I have just recently been informed as to the nature of this letter by other refuge managers. I regret that I did not know about this before, because it is probably too late to find a student biologist at this time. However, inquiries are being sent to Mr. A. Leopold and others.

In view of these conditions it does not seem advisable to continue mapping unless necessary arrangements can be made to have suitable personnel on the refuges other than the Lower Souris Refuge, where Mr. Hammond can continue mapping after he is done with his nesting studies.

However, it is hoped some kind of an arrangement can be made so that mapping projects can be continued.

If so desired I will correct and continue field mapping of unfinished units and copy field maps on tracing cloth so that black line prints can be made of them. This will take considerable time because it will have to be sandwiched in with the other work.

Tree and Shrub Planting: Upon further checking on the tree and shrub planting on different refuges it was evident that the large quantity of planting stock that was sent to the refuges late in the season was planted hastily and many cases were not properly sodded back. On such refuges it appeared to be a choice ofeeither planting part of the planting stock properly and throwing the rest away or planting all of it hurriedly.

These observations further show the advantage of transferring planting stock in the fall and heeling them in at the refuges where they will be planted the next spring.

Growth of Marsh and Aquatic Plants. Upper Souris Refuge: From time to time observations have been made on marsh and aquatic plants in the lower pondsite of Upper Souris Refuge.

Hard stem bulrush (Scirpus acutus) planted in 1936, 37, and 38 are doing very well. They will furnish much desired nesting habitat for diving ducks and are spreading over bare mud flats. Another attempt has been made to introduce wild rice (Zizania aquatica) this year. At present it appears that we have a nice bed started. Leaf blades of rice are already floating on the water.

Upon walking over the marsh areas, the dense growth pondweed (Potamogeton spp.) was a pleasant surprise. P. foliosus was very abundant. Here and there in the dense beds of P. foliosus were some P. pectinatus, P. perfoliatus, Myriophyllum spicatum, Zannichellia palustrus and Ceratophyllum demersum. P. pectinatus, P. perfoliatus Zannichellia palustrus were particularly common in shallow water along marginal to the old river bank.

Of the duck potatoes (Sagittaria spp.) S. latifolia, S. heterophylla, S. cuinata, and S. natan (?) were common.

Judging from previous observations made since 1935, it is probable that the much desired sago pondweed (Potamogeton pectinatus) will gradually replace the leafy pondweed (P. foliosus). Furthermore the presence of coontail (Ceratophyllum demersum) will probably never become abundant enough to choke out other more desirable aquatic vegetation. In fact, judging from observations of sloughs along the river in 1935, the reverse is liable to result.

Check Lists: Last month a program was proposed to standardize field observations of refuge personnel by having check lists started on the refuges. So far nothing has been heard about this proposed project.

Census: The following census program was lined up.

All refuge managers in our district have or are planning to carry out some form of census work, consequently these statements should not be considered a project for census work but rather an aid for those doing census work and for correlating it with similar census work done on other refuges in the district.

Since census work will furnish much desired information on the productivity of our refuges, accuracy is necessary. If there is doubt about the specie of duck because they are to far away or for some other reason, it will be much more accurate to tally such observations as ducks rather than to guess.

During the past years, two or more census have been made a month on most of the refuges. Since birds are liable to fly between refuges, (particularly Lower Souris, Upper Souris, Des Lacs, and Lostwood refuges) it appears desirable to have waterfowl census on definite dates. The tenth and twenty-fifth of each month are chosen dates for census. If these dates happen to be on Saturday, census work should be done on Friday, and if these dates happen to be on Sunday, census work should be done on the following Monday. In this manner we will be able to use CCC labor in census work.

After our first attempt at census or rather estimate on census, the following ammendment was added.

(Waterfowl Census cont.)

Ammendment to proposed waterfowl census: During the past two weeks refuge managers have been contacted as to the feasability of doing census work on the 10th and 25th of each month as previously planned in memo of May 13, 1938.

We are very fortunate to have Mr. E. R. Kalmbach, Senior Biologist of the Research Division in our district at Lower Souris Refuge. As a result of Kalmbach's work, with Mr. Henry, and Mr. Hammond on census it was agreed upon that census or estimate on census once a month would be sufficient.

In view of these facts it appears desirable to have census or attempted estimate on census work the 25th of each month. However, a much more complete picture can be had if it is feasable to have census the 10th and 25th as previously planned.

As a result of his previous nesting studies, Kalmbach suggests that we should be extremely conservative on our estimates on females and duck broods when a large number of males have been tabulated. He sites examples where large numbers of males have been observed and yet surprisingly small numbers of nests and female birds could be found in the immediate vicinity after it had been carefully field checked.

Botulism: All availeable knowledge on previous botulism outbreaks At Des Lacs Refuge have been sent in. More studies will be carried on at this refuge because ~~at the present~~ the Upper Des Lacs lake has been proving itself to be a death trap.

Three or four redheads died at Medicine Lake Refuge, probably from Botulism. If this is the case it appears that the virulent effect of the toxin was not altered during the winter and it was still in sufficient concentration in the bottom to be harmful.

It was thought that lead poisoning might have caused these birds to die, but no lead shot or remainsoof shot could be found in the crop or in other parts of the intestinal track.

John H. Steenis
Assistant Refuge Manager
June 15, 1938

(Waterfowl Census cont.)

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John H. Steenis
Assistant Refuge Manager
June 16, 1938

NARRATIVE REPORT OF
ACTIVITIES
APRIL, 1938

Tree and Shrub Planting: Most of the month of April was spent on helping out and checking on tree and shrub planting projects. At Upper Souris, Des Lacs, Lostwood refuges, time was spent on checking and seeing to it that planting stock was cared for, properly planted, and desirable locations chosen.

These tree and shrub planting projects definitely showed that if the digging, loading, and transferring could have been handled during some other season, it would be a great help. Spring is one of the busiest times of the year on a refuge. There is the farming and marsh and aquatic programs, patrol roads to be reconditioned after spring run-off, and other projects being started. On refuges having nurseries like Lower Souris, it is particularly difficult to do much planting when labor is spent on digging up nursery stock and prepareing it for shipment.

Naturally anything to lesson the concentration of work during spring would be a big help. In view of the fact that it is a common practice to heal stock in, in the fall, and in many cases to transfer and then heal in stock, why would it not be a very worth while procedure to transfer and heal in stock in the fall of the year rather than in the spring. The Great Plains Experiment Station of the Forest Service at Mandan, North Dakota, The Bottineau School of Forestry, North Dakota, and other commercial nurseries in the Dakotas are known to follow this practice.

Cover Type Mapping: As mentioned in the last narrative, not much progress has been made on cover type mapping. However, Assistant of technician has been secured for mapping at the Des Lacs Refuge.

Marsh and Aquatic Planting: For the most part projects on marsh and aquatic planting will be done in May, June and July. Though projects on marsh and aquatic planting for the refuges were sent in some time ago they have not been returned. Judging from a recent conference with Mr. Gillett, it appears that the proposed projects are at the Washington Office. However, CCC projects covering marsh and aquatic planting have been approved and on that basis, cord grass, hardstem bulrush, and wild rice is being planted at Upper Souris Refuge. All the wild rice is planted.

At the Des Lacs Refuge, cord grass, hardstem bulrush, and prairie bulrush is being planted. Cordgrass and hardstem bulrush are of particular significance for preventing erosion on dams, Careful field check is being made on this marsh planting.

Tree Thinning, Lower Souris Refuge: At the Lower Souris Refuge there had been some cutting of timber which had caused a misunderstanding. The main idea was to thin out dense stands so as to improve the existing tree growth and at the same time allow enough light to filter through so that desirable understory for wildlife could assert itself. Some of the timber that was removed could be used for fence posts. This particular problem was gone over in detail in the field with Mr. Henry, Refuge Manager.

Fish Stocking, Souris Refuges: The following is a proposed fish planting program for the Souris refuges.

PROPOSED FISH PLANTING PROGRAM
FOR UPPER AND LOWER SOURIS REFUGES

On the Upper and Lower Souris Refuges there is a project, that of fish stocking, that needs immediate consideration.

Environment

Depth and Oxygen Supply: In the upper pondsite of Lower Souris Refuge and in all pondsites of Upper Souris Refuge, including the reservoir Lake Darling, there is over 15 feet of water.

It appears that there is sufficient depth in these bodies of water to insure enough oxygen content over and above that necessary for decay and respiratory processes of aquatic life sothat fish will not die from lack of oxygen during the winter freeze over. (These conclusions are based on lake studies made by the writer while with the Wisconsin Land Inventory 1930-1935 and on the more intensive and precise studies of professors E. A. Birge, C. Juday and associates of the Limnological Laboratory of the Wisconsin Geological and Natural History Survey.)

Salt Concentration of Water: Some idea of the salt concentration can be had from the bound or fixed CO_2 tests.

Fixed CO_2 Analysis

Location	Date of collection	Date of tests	Parts per million of fixed CO_2
Upper Souris Refuge			
Mouse River at McKinney (Pond #41)	12-17-37	1-11-38	135.5
Lake Darling	12-6-37	1-11-38	165.0
Unit #96	12-6-37	1-11-38	225.5
Lower Souris Refuge			
Mouse River at Dam #1	1-6-38	1-11-38	177.5
Mouse River Area #332	12-7-37	1-11-38	182.5
Mouse River Area #341	12-7-37	1-11-38	235.0
Headquarter's Bay Area #326	12-8-37	1-11-38	307.0

(Since fixed CO_2 is constant, tests were not made immediately)

Food Supply: Field observations of 1935, 1936, and 1937 by the personnel employed on this refuge and by the writer certainly shows that there is an ample supply of forage fish, or minnows necessary as food for game fish. Fresh water shrimp and particularly large numbers of aquatic insects have also been observed in these waters.

Of the marsh and aquatic plants that have a direct and indirect bearing on fish life, beds of leafy pondweed (Potamogeton foliosus) and swamp smartweed (Polygonum muhlenbergii) are worthy of special note. Other pondweeds in this area are sago pondweed (Potamogeton pectinatus) and redhead grass (P. richardsonii).

Observation on Age and Fish Growth: It is to be regretted that very little work has been done on field studies dealing with the growth of fish in reference to there age. Recently a 16 pound northern pike (Esox lucius) was caught by locals just north of the refuge. Scale studies show that this fish was 7 years old. Upon further checking on old notes it appears that this is an excellent growth for this fish and tends to indicate that food conditions for game fish are very good. It is also interesting to note that this fish must have devoured 260 to 270 pounds of food, mainly minnows, in order to reach the weight of 16 pounds.

Fish Suitable for Planting

Before planting fish it is desirable to know whether wall-eyed pike or large mouth bass, and other closely related pan fish, are desired. It is necessary to make this choice because the piscivorous feeding habits of wall-eyed pike make them very undesirable in bass waters. In the lake states many bass lakes are being, or have been, ruined by the introduction of wall-eyed pike. Judging from the nature of the fish improvement work being previously asked for by Mr. Salyer, it appears that large mouth bass and related fish are desired.

In view of these facts it is hoped that a shipment of large mouth bass and pan fish such as blue gills, rock bass, and sunfish could be sent to these refuges.

It is very probable that these fish can be secured from the Upper Mississippi Waterfowl Refuge. At this refuge the Bureau of Biological Survey and the Bureau of Fisheries are cooperating and fish (fingerling size) probably can be acquired from this refuge.

I was informed by the regional office that this proposed fish program was not sent in because the Washington Office feared that asphyzation of fish would occur during the winter on the Lower Souris Refuge.

On the Lower Souris Refuge the upper pondsites hase sufficient depth (15 feet or more). Judging from previous field work on fish, this depth appears sufficient so that fish will not winter kill due to the lack of oxygen. However, the lower pondsites of this refuge are too shallow and asphyzation of fish is liable to occur during the winter.

However in the Upper Souris Refuge, this is not the case. Here there is necessary depth in all pondsites and there should be ample oxygen in the water during the winter for decomposition and respiration.

In view of these conditions it does appear desirable to plant fish in the Upper Souris Refuge.

The report "Fish Planting of Souris Refuges" includes accumulative data from which a definite decision might be arrived at for planting fish this season or in following seasons.

Nothing has been heard on this proposed fish stocking program.

Waterfowl Census: Because of the migration of waterfowl between refuges particularly those refuges that are close together (like Lower Souris, Upper Souris, Des Lacs, and Lostwood refuges) definite dates, the 10th and 25th of each month, are the days chosen for census.

This will prevent possible overlapping on tally because ducks have already been noted to fly between refuges. Having census at definite times will give some idea of how this district is producing as a unit.

Check-Lists: A proposed program has recently been drawn up to start making check-lists on Birds, Mammals, and Plants.

The importance of tabulating these field observations in the form of systematic check-lists is self explanatory. Check lists furnish a basic knowledge necessary for formulating biological policy and for figuring on the productive outflow of the refuges. From the standpoint of future [redacted] field work, knowledge of this type is of basic importance.

This work on check-lists cannot be completed at once. In fact it will take several years. A start has already been made in this direction on all refuges. The starting of check-lists will standardize and systematize these observations. Excellent work has been done along this line by Mr. Henry who has been fortunate in having more biological aid than other refuge managers.

The making of these check-lists should not be considered a work project. These correlations can be done by biological personnel of refuges while patrolling or doing other field work.

(Proposed program in check lists) CHECK-Lists

Though the bulk of our time and effort has been spent on administration and on projects dealing with refuge development, we have all been continually observing different species of bird, mammal, plant, and other forms of life.

It is very desirable that these observations are tabulated in a standardized form, the species being listed in order as found on accepted check lists or manuals on birds, mammals, and plants.

These check-lists will naturally be rather incomplete but nevertheless a desirable start can be made and eventually we should have a fairly complete knowledge on species of plant, and fauna of the refuges and the immediate vicinity.

Though it would be convenient to have study skins and specimens of all species shown on the check list it will be impossible to have them. However, in the case of plants, it will be advantageous to have collections of all plants shown on lists. Complete information is given on making plants specimens. If information on making bird and mammal skins is desired, it will be given and demonstrated when I visit your refuge.

Birds

The A. O. U. Check-list of North American Birds, 4th edition is commonly accepted by the American ornothologists as having the correct systematic arrangement on nomenclature on birds. Bird books which are in accord with the A. O. U. Check-List, 4th edition are: Birds of Canada by Taverner, Birds of Minnesota by Roberts, A Field Guide of the Birds by Peterson, and several others. All of us have one or more of these books.

Birds of America published by Garden City Publishing Company does not follow the systematic arrangement on nomenclature as given in the A. O.U. Check-List 4th edition and consequently should not be used as a standard for listing birds.

Mr. Henry of the Lower Souris Refuge, who has been alert as to the value of having collective information on bird, mammal, and plant species, suggests the following outline for check-lists on birds.

(See Proposed Outline)

Great care should be taken to have absolute accuracy in making these tabulations. If there is doubt, information should be shown by (?) or not at all.

The species can be named for most birds but it will be rather precarious to name subspecies unless specimens of birds have been sent to some well known authority and definitely varified.

Though the collecting of specimens is not permitted on refuges, ailing, dead, or obnoxuous birds found on refuges and birds in the vicinity of the refuges have been put up as study skins. This has already been done on some of the refuges in this district and should be encouraged on other refuges. Study skins serve as definite proof as to the locality in which certain species are found.

Mammals

A desirable field book for mammals is Field Book of North American Mammals by Anthony. Most of us have a copy of this book. The bulletin, A Biological Survey of North Dakota by Vernon Bailey gives valuable and rather complete information on fauna of North Dakota.

Here, as in birds, the putting up of study skins should be encouraged. However collecting is not permitted on refuges, but predators and rodents can be put up as study skins.

Included is a convenient form to use for making check lists on mammals.

Bird Check List for _____ Refuge

Specie	Bird Specimen Collected	List for Relative Abundance	Status	Nested 1935	Nested 1936	Nested 1937	Nested 1938	Nested 1939	Nested 1940
Common & Scientific Name		Shown by Number	Shown by Letter						
	E X	A	M	P	L	E			
Pied-billed Grebe *Podilymbus podiceps* (L.)	none	3	S.R.	X	X	X			

/ ~~1-Very abundant~~ /
2-Abundant
3-Common
4-Fairly Common
5-Uncommon
6-Rare
7-Accidental

/ ~~M-Migrant~~ /
R-Resident
S. R.-Summer Resident
W. R.-Winter Resident

Mammal Check List for_____Refuge

Specie	Specimen collected	Relative Abundance	Other Data
Common and Scientific Name		Shown by Number	
E X A M P L E			
Norway rat Rattus norvegicus (Erxleben)	none	3	

1-Very Abundant
2-Abundant
3-Common
4-Fairly Common
5-Uncommon
6-Rare
7-Accidental

Plants

There are several plant manuals that follow the systematic arrangement on nomenclature. Most of us have one or more of them. They are Gray's Manual 7th ed., Flora of the Prairies and Plains by Rydberg, Flora of North Dakota by Bergman, and others.

The vegetative cover type mapping projects afford an excellent opportunity to make a good start on plant check list and plant collection. Enough material should be collected so that a collection can be split 2 or 3 ways if necessary.

When pressing plants dorsal and ventral side of leaves should be shown and also as much of the floral characteristics as possible.

The following quotations from Spring Flora of Wisconsin by Professor N. C. Fassett explains, "How to Press Plants".

"The usual method of preserving flowering plants and ferns for study is by pressing. The plant is laid in a single page of newspaper, folded once, and dried under pressure. For this the botanist uses sheets of heavy blotting paper (the "deadening felt" sold by most hardware stores and lumber dealers is excellent) cut to 12 x 18 inches. One of these blotters, usually termed "driers", is placed on a table, and on it the open sheet of newspaper. The plant specimen is laid on one half of the paper; the other half is folded over it, and another drier put on top. Another plant in a newspaper follows, then another drier, etc. When all the plants are put in press, a board, a lattice-work frame, or beaver-board, is placed above and another below, and the whole is strapped or tied tightly or placed under a heavy weight.

After an interval of from 6 to 24 hours the driers should be changed for fresh crisp ones, and the old damp driers baked in the sun or artificial heat. After that a careful worker will change driers every 24 hours until the plants are stiff and dry. When done they will usually not feel cold to the touch, and will not droop limply when picked up.

The amateur will find several thicknesses of newspaper nearly as satisfactory as the felt driers. These may be used folded in half, and if they are laid down with the fold on the right-hand side, and the single folded sheets holding the plants have the fold on the lefthand side, there will be little danger of taking out plants by mistake when the driers are changed."

Such plant collections should have the following data: name, locality, date, habitat, name of collection and collection number.

Collections that are sent out for identification should be left loose in newspapers and not glued and fastened on herbarium paper since the plant specimens are more convenient for identification when loose.

If plant collections are put up as regular herbarium specimens they should be glued on regular stiff white herbarium paper and held more securely to the paper by strips of translucent gummed paper or transparent tape.

The following method is most convenient for glueing plants to herbarium paper. First cover a piece of window glass or smooth tin with a diluted glue solution. A small cheap paint brush is desirable for this job. Then place plant specimen on glue, lift it up with a forceps and dissecting needle and place on herbarium sheet. Next place a piece of wax paper over specimen and then another herbarium sheet and repeat the method for the next collection. (The wax paper keeps specimens from sticking to one another and can be used again.) Herbarium specimens prepared in this manner should be covered with a board or plant press and weighted down. When specimens are dry they should be reeinforced with strips of translucent gummed paper or like substance. Labels telling necessary information on collection should be placed on the lower right-hand corner.

The following is a desirable form for making a plant check list.

Plant Check-List for_____Refuge

Specie	Specimen Collected	Relative Abundance	Other Data
		Shown by Number	
E X A M P L E			
Cat-tail Typha latifolia L.	X	4	

1-Very Abuhdant
2-Abundant
3-Common
4-Fairly Common
5-Uncommon
6-Rare
7-Accidental

John H. Steenis
Assistant Refuge Manager
May 20, 1938

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF BIOLOGICAL SURVEY

ADDRESS REPLY TO REGIONAL DIRECTOR AND REFER TO

Marsh & Aquatic Planting

OFFICE OF REGIONAL DIRECTOR
406 POST OFFICE BUILDING
OMAHA, NEBRASKA

REGION No. 9
N. E. MONTANA
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS

March 28, 1938

Chief, Bureau of Biological Survey

Washington, D. C.

Attention: J. Clark Salyer

Dear Sir:

There is enclosed a copy of a memorandum entitled "Preliminary Notes on March and Aquatic Vegetation North Dakota" submitted by Mr. John H. Steenis. These notes were distributed to the various refuge managers.by Mr. Steenis.

Apparently, Mr. Steenis has gone to considerable pain in compiling this information. Certain items in these notes are valuable for information of the various refuge managers, for example, the planting date for these various species.

Very truly yours,

Burnie Maurek, Regional Director

By J. C. Gillett

Associate Refuge Manager

Enclosure

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

REGION No. 9
N. E. MONTANA
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS

OFFICE OF REGIONAL DIRECTOR
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Very truly yours,

Burnie Maurek, Regional Director

By [signature]

Associate Refuge Manager

Enclosure

PRELIMINARY NOTES ON MARSH AND AQUATIC VEGETATION NORTH DAKOTA

During the past three years we have all been engaged in part, in guiding and hurrying Nature in furnishing refuges with desirable marsh and aquatic vegetation. Various methods of planting have been used with varied success.

On the basis of the work done in our district and elsewhere, an attempt is being made to describe some of the more desirable marsh and aquatic plants with reference to food value, environmental requirements, and propagation for refuges of our locality. Information on propagation of these plants is shown in a chart at the conclusion of this report.

This accumulative information given in this memo is not complete, since this field is relatively new. Continued work on marsh and aquatic vegetation will lead to other information which will be of value to all of us in doing this work in the future.

Pondweeds (Najadaceae)

Species: Of the pondweeds found in this district Sago pondweed (Potamogeton pectinatus), leafy pondweed (P. foliosus), redhead grass or clasping leafed pondweed (P. perfoliatus var. richardsonii) and wigeon grass (Ruppia maritima), are most important.

Since these plants have similar characteristics they will be discussed as a group.

Value: All these plants, particularly Sago pondweed and redhead grass are well known duck foods and little need be added on this subject.

However, there is another point of particular significance to consider. Field observations tend to show that areas, where there is large beds of aquatic plants, are not inflicted with western duck sickness or botulism.

The causative organism for this malady is the bacteria Clostidium botulinium type C, which secretes the virulent fatal toxin that has killed ducks. This bacteria is an anaerobe and consequently can not exist in the presence of free oxygen. On the other hand aquatic chlorophyl bearing plants produce free oxygen by their photosynthetic processess and consequently appear to cause a non-desirable environment for anaerobic life. In other words the presence of green aquatic plants purify the water so that a serious botulistic condition will not develpp. These statements with reference to botulism and aquatic plants should be regarded as a supposition and not as facts, since I do not know of any experimental work done on this subject.

(Pondweeds, continued)

Environmental Requirements: It is obvious that these plants grow only in water, nevertheless they appear to be able to live over in those places that become dry during late summer fall. This is due to the fact that sufficient nourishment is stored in the rootstocks and tubers.

These aquatic plants, particularly wigeon grass and sago pondweed can grow in fairly brackish waters.

Aquatic vegetation cannot thrive in badly roiled waters. Anyone who has observed ox-bows of streams with a heavy growth of water plant life as compared to streams with out plant life would readily note this characteristic of aquatic gegetation. The significance of these statements were further proven by a series of experimental plot studies made in the Des Lacs Refuge in 1936.

In view of these facts it is obvious that a badly roiled water condition must be corrected before doing aquatic planting.

Judging from field observations made on the Upper Souris and Arrowwood refuges it appears that a green scum or bloom due to plankton and other algae are not so detrimental to the growth of aquatic plants as roiled water.

Water Plantains
(Alismaceae)

Species: Of the Water Plantain Family, the Sagittarias, particularly duck potato (Sagittaria latifolia) is of some significance.

Value: There has been a lot of talk praising this plant as a duck food. For the most part, it has been over done. This is probably due to the fact that the closely related delta potato (Sagittaria platyphylla) which is of great value as a duck food in the southern states. However, this plant like other marsh vegetation aids in preventing roiled waters when planted marginal to the water.

Environmental Requirements: This plant grows marginal to the water and in the water to about 10" in depth. It is not so lenient in brackish water as other vegetation.

tolerant of

Marsh Grasses
(Gramineae)

Species: Of the many desirable species of marsh grasses, we will limit ourselves to the 3 species, wild millet(Echinochloa crusgalli), wild rice (Zizania aquatica), and cord grass (Spartina michauxiana).

Marsh Grasses
(Continued)

Wild Millet

Value: Wild millet has a 2 point value for food and cover. Both the grass sprouts and the seeds are desired by geese and ducks. When planted marginal to the water it will aid in preventing the water from becoming muddy due to wave action.

Environmental Requirements: Wild millet, an annual, requires a saturated to near saturated condition for germination and initial growth. After that it can stand varied conditions. The seed is known to hold life even if it lays over for 2 years or more. It will grow in fresh to fairly brackish water.

Wild Rice

Value: Wild rice has often been acclaimed as one of our most valuable food cover plants for waterfowl.

Environmental Requirements: Wild rice has definite requirements that must receive consideration if satisfactory results are to be obtained.

(1) It will grow in fresh to slightly brackish water.
(2) An exchange of water through all or part of the season is desired.
(3) Depth for planting is 6" to 36", 12" to 24" being most desirable.
(4) Bottom soil having a layer or covering of partly broken down dead vegetation is desirable for sowing rice seed. For example, wild rice very readily reseeds itself in its partly decayed straw. In 1936 on the Des Lacs Refuge a good catch was made in a flooded field that was covered with remains of Russian Thistle. At Lower Souris Refuge wild rice planted in locations marginal to heavy vegetation where plant remains tended to form cover on the bottom, was successful.

This particular requirement for wild rice appears necessary so that this bristled awned seed will be able to work its way down so that it will not be so readily found by waterfowl. Some believe that a buried condition is necessary for a proper germination of the seed.

(5) One of the most important and least considered environmental requirement of wild rice is that of a constant water level. It was known to stand a slow drop in water level but has again and again proven that it will not live where there are sudden changes in water level even of 5 or 6 inches. This fact was brought out at the Lower Souris Refuge during 1937 and is an old story in the extensive rice beds of the Great Lakes States.

Wild Rice
(Continued)

In view of these facts it is absolutely essential to have a controlled constant water levels during the growing season if satisfactory results from planting wild rice are desired.

Cord Grass

Value: Nesting studies at Lower Souris Refuge revealed that cord grass was one of the most desirable cover plants for nesting waterfowl. The ability of the stalk and leaf-remains of this plant to stand up during winter and early spring furnished desired early season cover.

This plant is of particular significance in furnishing our small nesting islands with desirable cover. The extensive rhizomb and root growth will tend to hold and build up the soil on these islands and thus insure their permanency.

Environmental Requirements: This plant is very hardy. It will live under drouth conditions and is known to thrive in 12" depths of water. Varied water levels will not effect it; in fact, field observations show that sudden changes from aquatic to dry and back to aquatic condition during one season does not bother this plant.

Rushes
(Of the Cyperaceae)

Spiked Rushes

Species: Of the two spiked rushes in our district, common spiked rush (Eleocharis palustris) and the slender or needle spiked rush (Eleocharis acicularis), slender spiked rush deserves special consideration.

Value: This minute slender spiked rush growing in dense mat was observed to be grazed on by baldpate and to a lesser extent by the gadwall.

The presence of a rhizomb spreading mat growth of this plant would be of particular significance on water filmed mud flats where a botulistic condition is liable to develop. Extensive planting of this plant is limited since, though common, it is not found in abundant quantities.

Environmental Requirements: Environmental requirements of this plant further add to its value since it has been observed to thrive in spite of varied water conditons, whether it be submerged or on dry mud flats.

Bulrushes

Species: Of the several bulrushes in our area the hardstem bulrush (Scirpus acutus) and prairie bulrush (Scirpus pallidosus) are the most important in our marsh planting work.

Value: Both these bulrushes are desirable for furnishing cover, and prairie bulrush appears to be of particular significance as a food plant.

Another valuable asset of these rushes is their ability to prevent roiled water due to wave action when marginal to the shore. A lack of roiled water results in a suitable environment for aquatic plants. The presence of such marsh and aquatic vegetation plus a lack of bare mud flats will result in an environment not so suitable for botulism.

Prairie bulrush is of particular importance because it will spread more readily than the hardstem bulrush and can grow in more brackish waters.

Dense beds of bulrushes, particularly hardstem bulrush can be improved for waterfowl, such as the diving-duck, by digging root-stocks for transplanting along meandering channels 10 to 20 feet wide. For example, canvasbacks nested in bulrushes marginal to such channels on the Lower Des Lacs Lake for the first time in 11 years in 1936.

The tendency of hardstem bulrush to grow a rip-rap of rhizombs that effectively resist erosion will insure the presence of small islands and will protect the more exposed parts of the larger islands.

Environmental Requirements: Hardstem bulrush grows in fresh to fairly brackish water from slightly above water level to about 3 feet below water level.

Prairie bulrush grows in fairly fresh to brackish water from slightly above water level to 18" below water level.

Both species seem able to survive a certain amount of water fluctuation.

Smartweed
(Of the Polygonaceae)

Species: Two smartweeds of particular importance in our district are pale smartweed, (Polygonum lapathifolium) and swamp or marsh smartweed (P. muhlenbergii).

(Smartweed, continued)

Value: Both these smartweeds are excellent foods for waterfowl, and also good cover during summer and fall.

Swamp smartweed is of particular benefit because of its ability to live in varied water levels and to follow up receeding water levels. Originally many of the sloughs of the prairie region that were so much desired by waterfowl were surrounded partly if not entirely by this smartweed. This accounts for its local popular name, "stew weed". The encroaching of this plant on the water margin is not desirable for a botulistic condition.

Environmental Requirements for Pale Smartweed: Pale smartweed grows in marsh to mesophyte condition. It is desirable to plant marginal to water but not in water.

Plant Propagation

Conclusion on method for planting marsh and aquatic plants is taken from the results of previous planting by Biological Survey personnel in our district and also of others who have done work on species mentioned in this report. On the following chart on plant propagation the (*) have not been sufficiently tried out to warrant satisfaction.

John H. Steenis
Assistant Refuge Manager
3/10/38

CHART ON PLANT PROPAGATION

Specie	Reproductive Part	Method of Storage	Date for Planting	Method of Planting **
Sago Pondweed (Potamogeton pectinatus)	Seeds	Cold water storage in winter. Cold damp storage in plant remain or like substance during winter.	Spring break-up to July 1.	Rake in just befor flooding. Clay balls, depth of 6-36".
	Tubers	Cold water storage. Cold damp storage straw or like substance.	Same	Pressing into bottom mud. Clay balls, depth of 6-36"
	Leafy stems	Water Storage 1 - 3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud, or by using clayballs.
Redhead grass (P. obtusifolius)	Same as above	Same as above	Same as above	Same as above
Leafy Pondweed (P. foliosus)	Seeds	Cold water storage in winter.	Spring break-up to July 1	Rake in just before flooding Clay balls at depth of 6-36"
	Root-Stocks	Cold water storage or damp storage in straw or like substance.	Same as above	Press in bottom mud Clay balls depth of 6-36".
	Leafy stems	Water storage 1 - 3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud or Clay balls depth 6-36".
Wigeon Grass (Ruppia maritima)	Seeds *	Cold water storage Damp storage in straw or like substance.	Spring break-up to July 1	Soak seed until it sinks, then broadcast, depth 6-36".
	Root-stocks. *	Same as above	Same as above.	Press in bottom mud, or Clay balls, depth 6-36"
	Leafy stems	Water storage 1 - 3 days, better to plant immediately.	June 15 to Aug 1	Clump of 4-6 leafy stems pressed in bottom mud or by using clay balls depth 6-36"
Duck potato (Sagittaria latifolia)	Seeds (Not dependable) ?	Cold water storage in winter. ?	Spring break-up to June.	Plant at water level to depth of 10".
	Tubers	Cold water storage during winter, cold damp storage in straw or like substance. ?	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
Wild Millet (Echinochloa crus-gallii)	Seed	Dry storage	Spring break-up to July 1	Sow or drill.
Wild Rice (Zizania aquatica)	Seed	Keep moist and plant immediately. Cold storage during winter.	Sept. to period of freeze-up Spring break-up to Sept.	Sow in water, depth 6-36"
Cord Grass (Spartina michauxiana)	Rootstocks	*Damp storage during winter, * Transplant directly.	Spring break-up to (*) Aug.	Press in or cover with thin layer of soil.
Needle rush (Eleocharis acicularis)	Whole plant	* Keep moist * Damp storage during winter. Transplant directly	Spring break-up to Septl *	Press in soil slightly above or below water level.
Hardstem bulrush (Scirpus acutus)	Root-stocks or whole plant	Left in piles with dirt left on. Damp cold storage, cold water storage. Damp	Spring break-up to freeze-up	Press in bottom soil at water level to 3 feet below water level. Best results from spring to summer planting.
Prairie bulrush (S. pallidosus)	Tubor or whole plant	Piled outside and covered with dirt and straw. Damp cold storage, water storage.	Spring break-up to freeze-up	Press in bottom soil at water level to 18" below water level.
Pale smartweed (Polygonum lapathifolium)	Seed	Dry storage	Spring break-up to June 15	Drill or sow and rake in at depth of slightly above water level to water level. (Grows best: mixed with wild millet)
Swamp Smartweed (Pl muhlenbergii)	Seed	As yet have not heard of satisfactory results from seed planting.		
	Whole plant Stem cuttings in lower part of stem at least 2 nodes long	Water storage several days	June 15 to Aug. 15	Anchor bottom so that there is 2-12" of water over top part of stem which must remain under water till it sprouts.
		Cold water storage during winter for stem cuttings.	Spring break-up to June!	Same as above

CHART ON PLANT PROPAGATION

Species	Reproductive Part	Method of Storage	Date for Planting	Method of Planting
Sago Pondweed (Potamogeton pectinatus)	Seeds	Cold water storage in winter. Cold damp storage in plant remain or like substance during winter.	Spring break-up to July 1.	Bake in just before flooding. Clay balls, depth of 6-36".
	Tubers	Cold water storage. Cold damp storage in straw or like substance.	Same	Pressing into bottom mud. Clay balls, depth of 6-36"
	Leafy stems	Water storage 1 - 3 days, better to plant immediately.	Same as above. June 15 to Aug. 1	Clumps of 4-6 leafy pressed in bottom mud, or by using clayballs.
Redhead grass (P. obtusifolius)	Same as above	Same as above	Same as above	Same as above
Leafy Pondweed (P. foliosus)	Seeds	Cold water storage in winter.	Spring break-up to July 1	Bake in just before flooding Clay balls at depth of 6-36"
	Root-stocks	Cold water storage or damp storage in straw or like substance.	Same as above	Press in bottom mud Clay balls depth of 6-36".
	Leafy stems	Water storage 1 - 3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud or Clay balls depth 6-36".
Wigeon Grass (Ruppia maritima)	Seeds *	Cold water storage Damp storage in straw or like substance.	Spring break-up to July 1	Soak seed until it sinks, then broadcast, depth 6-36".
	Root-stocks. *	Same as above	Same as above.	Press in bottom mud, or Clay balls, depth 6-36"
	Leafy stems	Water storage 1 - 3 days, better to plant immediately.	June 15 to Aug. 1	Clump of 4-6 leafy stems pressed in bottom mud or by using clay balls depth 6-36"
Duck potato (Sagittaria latifolia)	Seeds (Not dependable)	Cold water storage in water.	Spring break-up to June.	Plant at water level to depth of 10".
	Tubers	Cold water storage during winter, cold damp storage in straw or like substance.	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
Wild Millet (Echinochloa crus-galli)	Seed	Dry storage	Spring break-up to July 1	Sow or drill.
Rice Cutgrass (Leersia oryzoides)	Seed	Keep moist and plant immediately. Cold storage during winter.	Sept. to period of freeze-up	Sow in water, depth 6-36"
Bur-reed (Sparganium angustifolium)	Seed	Keep moist and plant immediately. Cold storage during winter.	Spring break-up to July 1	Press in bottom mud Clay balls depth of 6-36".
	Root-stocks	Damp storage during winter. * Transplant directly.	Spring break-up to Sept. *	Press in bottom soil at water level. Best results from spring planting.
Arrowhead (Sagittaria latifolia)	Tubers	Left in piles with dirt left on. Damp cold storage. cold water storage.	Spring break-up to freeze-up	Press in bottom soil at water level to 3 feet below water level. Best results from spring planting.
	Plant or whole plant (S. pallidus)	Piled outside and covered with dirt and straw. Damp cold storage. water storage.	Spring break-up to freeze-up.	Press in bottom soil at water level to 18" below water level.
Pale smartweed (Polygonum lapathifolium)	Seed	Dry storage (Germ best mixed with wild millet)	Spring break-up to June 15	Drill or sow and rake in at depth of slightly above water level to water level.
Swamp Smartweed (Polygonum coccineum)	Seed	As yet have not heard of satisfactory results from seed planting.		
	Whole plant	Water storage several days	June 15 to Aug. 15	Anchor bottom so that there is 5-12" of water overtop part of stem which must remain under water till it sprouts.
	Stem cuttings in lower part of stem	Keep moist	Spring break-up to Sept. *	Press in bottom soil at water level. Best results from spring planting.
	At least 2 nodes	Cold water storage during winter. for stem cuttings.	Spring break-up to June.	Same as above

NARRATIVE REPORT OF ACTIVITIES FOR MARCH, 1938

Aleutian Report

I am planning to finish cataloging the pictures for the Aleutian Report in the latter part of April or early part of May.

On receiving further identification on Aleutian plants, field notes on plant distribution will be worked over and sent to the Washington Office.

North Dakota Refuges

During the past 2 weeks not much time has been spent drawing up work programs on biological improvements for spring and early summer because for the most part, this has already been done.

Field trips and conferences have been made with refuge personnel on the Des Lacs, Medicine Lake, Lostwood, Upper Souris and Lower Souris refuges.

The main purpose of these trips was to get organized so that projects on biological programs could be carried out, and so a better understanding can be had on refuge problems for working on programs of the immediate future.

Cover Type Mapping: Very little progress has been made on cover type mapping with the exception of the Lower Souris Refuge. During the fall, assistant to technician on Des Lacs, Upper Souris, and Arrowood refuges were carefully trained to map. At the present time the Des Lacs and Upper Souris refuges do not have these men available since they are being used for other work. At Arrowood Refuge the camp is about to be disbanded and the assistant to technician goes out with the camp. Medicine Lake CCC Camp never had a technician. Repeated efforts of Mr. Kreager and myself to get an assistant to technician have been to no avail. The use of CCC boys in cover type mapping has proven unsatisfactory since they lack basic training that insures an accurate peice of work. In view of these above facts, cover type mapping will progress very slowly.

Fish Planting for Souris Refuges

On the Upper and Lower Souris Refuges there is a project, that of fish stocking, that needs immediate consideration.

Environment

Depth and Oxygen Supply: In the upper pondsite of Lower Souris Refuge and in all pondsites of Upper Souris Refuge, including the reservoir Lake Darling, there is over 15 foot of water.

It appears that there is sufficient depth in these bodies of water to insure a sufficient oxygen content over and above that necessary for decay and respiratory processes of aquatic life so that fish will not die from lack of oxygen during the winter freeze over. (These conclusions are based on lake studies made by the writer while with the Wisconsin Land Inventory 1930-1935 and on the more intensive and precise studies of professors E. A. Birge, C. Juday and associates of the Limnological Laboratory of the Wisconsin Geological and Natural History Survey.)

Salt Concentration of Water: Some idea of the salt concentration can be had from the bound or fixed CO_2 tests.

Fixed CO_2 Analysis

Location	Date of collection	Date of test	Parts per million of fixed CO_2
Upper Souris Refuge			
Mouse River at McKinney (Pond #41)	12-17-37	1-11-38	135.5
Lake Darling	12-6-37	1-11-38	165.0
Unit #96	12-6-37	1-11-38	225.5
Lower Souris Refuge			
Mouse River at Dam #1	1-6-38	1-11-38	177.5
Mouse River Area #332	12-7-37	1-11-38	182.5
Mouse River Area #341	12-7-37	1-11-38	235.0
Headquarter's Bay Area #326	12-8-37	1-11-38	307.0

(Since fixed CO_2 is constant, tests were not made immediately)

Food Supply: Field observations of 1935, 1936 and 1937, by the personnel employed on this refuge and by the writer certainly shows that there is an ample supply of forage fish, or minnows necessary as food for game fish. Fresh water shrimp and particularly large numbers of aquatic insects have also been observed in these waters. Of the marsh and aquatic plants that have a direct and indirect bearing on fish life, beds of leafy pondweed (Potamogeton foliosus) and swamp smartweed (Polygonum muhlenbergii) are worthy of special note. Other pondweeds in this area are sago pondweed (Potamogeton pectinatus) and redhead grass (P. richardsonii).

Observation on Age and Fish Growth: It is to be regretted that very little work has been done on field studies dealing with the growth of fish in reference to there age. Recently a 16 pound northern pike (Esox lucius) was caught by locals just north of the refuge. Scale studies show that this fish was 7 years old. Upon further checking on old notes it appears that this is an excellent growth for this fish and tends to indicate that food conditions for game fish are very good. It is also interesting to note that this fish must have devoured 260 to 270 pounds of food, mainly minnows, in order to reach the weight of 16 pounds.

Fish Suitable for Planting

Before planting fish it is desirable to know whether wall-eyed pike or large mouth bass, and other closely related pan fish, are desired. It is necessary to make this choice because the pisavorous feeding habits of wall-eyed pike make them very undesirable in bass waters. In the lake states many bass lakes are being, or have been, ruined by the introduction of wall-eyed pike. Judging from the nature of the fish improvement work being previously asked for by Mr. Salyer, it appears that large mouth bass and related fish are desired.

In view of these facts it is hoped that a shipment of large mouth bass and pan fish such as blue gills, rock bass, and sunfish could be sent to these refuges.

John H. Steenis

John H. Steenis
Assistant Refuge Manager
April 21, 1938

NARRATIVE REPORT OF ACTIVITIES
FEBUARY 1938

Index

WEC 3-24-38

NARRATIVE REPORT OF ACTIVITIES
FEBRUARY 1938

Aleutian Island Report

There has been such a rush to get work programs of a biological nature lined up for refuges of this district that time had to be deliberately taken out to complete my contribution to the Aleutian Island report.

While on the Aleutian Expedition it was agreed upon that Mr. O. J. Murie, chief of our party, would work up the report. Each one of our party was to work on a contribution to this report dealing with some phase of the field work. Mr. Douglas Gray, of the Alaskan Game Commissioner, contributed information on human relations with reference to future administration. Mr. Murie's problem, aside from compiling the report, was on bird and animal life. Doctor V. Scheffer contributed on marine and invertebrate life with particular reference to food habits. My problem dealt with the vegetation.

During the expedition we collected and gathered data on all phases of the work and were continuously involved in roundhouse discussions on various phases of ~~this project~~ job. Information and collections on different phases of the work has been turned over to the person working up this phase of the work.

Since the completion of our expedition the following have added more information particularly on nomenclature of plants: Mssrs. J. P. Anderson, Eric Hulten, Neal Hotchkiss, W. R. Maxon, J. R. Swallen, S. F. Blake, and N. C. Fassett.

Flora of the Aleutian Islands

The flora of the Aleutian Islands can be characterized as northern prairie or tundra because the vegetation of these islands is beyond the treeline. This is a rather striking feature in view of the fact that Anatigmak, the most southern of this chain of islands is quoted to be two miles north of London, England.

This arctic treeless condition of the islands is probably due to several factors of which the temperature and the nature of the soil are worth considering. Since the temperature of the Pacific Ocean and the Bering Sea that surround these islands remains on or about 42°F., the temperature of the islands range from slightly below freezing to slightly above 50°F. It is also probable that the raw condition of the soil due to its recent origin which, on being associated with other undesirable factors, also has much to do with the lack of trees.

Flora of the Aleutians

Vegetative Cover Type Maps

An attempt has been made to explain and describe the nature of the flora on these islands by making a cover type map of the vegetation on a part of Kanaga and Igitkin islands. Plots chosen for mapping had plant associations that were typical of the Aleutians, particularly those islands west of Unalaska. We are indebted to Mr. J. Tise, Assistant Technician CCC Camp BF-3, Kenmare, North Dakota for making finished copies of the original field maps.

The determination of the vegetative types was not placed entirely on an ecological basis. A definite understanding of plant ecology on the island did not seem possible and it was a relief to read Doctor F. Griggs' paper on The Problem of Arctic Vegetation. *

> He states, "Finally, however, I came to see the trouble. These northern vegetation types stand lower in the plant succession than any of the natural associations in the south. When I began to compare them with ephemeral weed vegetation of cultivated fields, a comprehension of arctic ecology began at once to dawn on me.
>
> Go out to one of the numerous real estate developments where they have made over the landscape recently and try to classify the weeds that appear. Cataloging the plants over several such developments, you will make a long list of familiar weeds. Now try to classify them as to habitat preference and their associations to each other." *

These statements appear to fit plant ecology on the Aleutian Islands in a nut shell.

The description of these types is general in that they were made to describe the different vegetative types for this chain of islands and not for the specific cover types as mapped on Igitkin and Kanaga islands. The dominant and some of the subdominant species are mentioned in the following description on plant types.**

Classification of symbols for vegetative cover types follows the plan for Vegetative Classification for Cover Mapping as presented by the Migratory Waterfowl and Wildlife Research divisions.

* Griggs, Robert F.
1934, Problem of Arctic Vegetation
Journal of the Washington Academy of Sciences, Vol. 24, page 168.

** Cover Type maps referred to are being sent with this Aleutian Report. to Murie.

Outer Belt of Vegetation

(G_1) Large Grass Type: One of the most notable and striking features of the Aleutian Islands is the marginal belt of Elymus mollis dominant type of vegetation which often extends well up the slopes of mountains and back along flats just off the beach. Subdominant plants worthy of note of this type are the two species of the Umbelliferae, Ligusticum scothicum and Conioselinum gmelini, and a specie of the Compositae, Senecio pseudo-arnica. Immediately marginal to the beach Honckenya peploides var. major, (Arenaria peploides) is invarably found.

This rank heavy growth hip to shoulder high with its tendency to grow in clumps is a definite impediment to walking. Nevertheless, the extensive rhizomb fibrous root growth and the tough fibered nature of the leaf blades and stems could be relied upon for aid in climbing almost perpendicular slopes.

This marginal belt of prominent vegetation had a distinct bearing on wild life. On nobs, chimneys, protruding cliffs and shelves covered with this rank plant growth, the bald headed eagle finds suitable nesting sites. This luxurious growth of vegetation also furnishes suitable nesting cover for the Pacific eider and the glaucous winged gull. Burroughing birds, particularly the tufted puffin, have formed honeycomb colonies for nesting, particularly in those places where the fox do not interfere. Foxes were also observed to have their dens (in part) in this outer belt of rank vegetation.

Vegetation in the Interior

The plant life inward from this outer growth of rank luxurious vegetation appeared to follow no ecological pattern. To be sure aquatics were found in the fresh water pools and lakes. Sedges were found in the more wet habitats, but never the less could be found anywhere. Generally speaking, there appeared to be a grand mix up of plants apparently lacking characteristics which would allow segregation of this vegetation into definite plant associations.

Often there was a dominance of certain plant species with apparently no ecological reason. On Kiska Island particularly in the southern part, raindeer moss (Cladonia spp.) was dominant. On a large part of Umnak Island grasses were dominant (not the large Elymus mollis). On many islands the crowberry (Empetrum nigrum) was dominant, and on other islands there were mixtures of plants previously mentioned as well as other tundra species that it is very convenient to refer to such vegetative cover as mix.

In the interior regions of these islands humps or miniature moors of peat 3 to 4 feet high are sometimes common. In some cases it appears that this condition is due to an accumulative growth of moss particularly club moss (Polytrichum spp. or closely related species) and Sphagnum. These small peaty hummocks often serve as places of rest and observation for the parasitic jaeger, the glaucous-winged gull, the baldheaded eagle, and the blue fox.

This inner area of vegetation does not appear to be so significant as the outer belt of vegetation for bird and animal life. Waterfowl, particularly the European teal, the greater scaup, red-throated loon, Aleutian sandpiper, and northern phalarope find suitable nesting sites in the vicinity of fresh water ponds and lakes. Apparently rock ptarmigan found suitable nesting sites in this range of vegetation. For the most part the smaller birds, the Alaskan longspur, the Aleutian song sparrow(?) the snow bunting, and on the islands to the eastward the Savannah sparrow, and the American pipit also found suitable nesting sites in this region of plant life. The birds mentioned above were not so numerous or concentrated as the sea birds observed marginal and on the shores of these islands. To be sure there were concentrated colonies of auklets in the interior, particularly on Semisopochnoi Island but this was not due to the vegetation but rather to extensive cavities and pockets resulting from a jumbled mix up of cliff like rock and boulders that were the result of the blowing up of a volcanic mountian during the past. These cavaties and pockets furnished ideal nesting sites for the auklets.

Vegetative cover types for plant life in the interior of these islands are: (B_1) Heath, (B_2) Alpine heaths, (G_2) Small Grass, (L_1) Cladonia, (M_{17}) Sedges and Rushes, (M_{25}) Sphagnum Bog, and (W_1) Sago pondweed.

(B_1) Heaths: The heath type of vegetation could be more correctly called the Empetrum nigrum (of the Empetaceae) type. Other heaths (of the Ericaceae) often prominent in this type are Phylodoce glanduliflora and Vaccinium vitis-idaea. Grass species often found growing with these heaths are Festuca rubra, and Calamogrostis canadensis var. scabra.

(B_2) Alpine Heaths: Alpine heath type was similar to the one discussed above. However, Empetrum nigrum is very dwarfed and invariably associated with Loiseleria procumbens. Cassiope hypnoides is also found growing in the higher more exposed habitats. No grasses were prominent in this alpine type.

(G_2) Small Grass: This small grass type is distinctly different from the (G_1) large grass type in that the large rank growth of Elymus mollis is not included in this type. The following in mixed or pure stand are the dominant species of Graminia usually found in this type: Festuca rubra, Poa artica, Calamagrostris canadensis var scabra, Agrostis borealis, Deschampsia caespitosa var. artica, and Puccinellia pumila.

Sedges particularly Carex rariflora are often found in this grass type.

Though the more conspicuous flowering plants were found in most of the types, they appear to be more noticeable in this smaller grass type. Some of the flowering plants worthy of note are: Frittilaria camschatkensus, Orchis aristata, Plantanthera spp., Anemone narcissiflora, Ranunculus nelsonii, Lupinus nootkatensis, Geranium erianthum, Chrysanthemum articum, Erigeron peregrinus, and Arnica sp.

From the standpoint of land use, extensive areas covered with a small grass dominant type have already shown themselves to be of valuable significance for the raising of sheep. On Umnak Island a sheep ranch has been very successful, and the wool shipped out is reported to be of a superior quality.

(L_1) Cladonia: The reindeer moss type (Cladonia spp. lichens) is often associated with subdominant moss species (Species of Musci) and some of the grasses previously mentioned. In more moist areas sedges (Carex sp.) were observed to be associated in this lichen.

In view of the fact that reindeer moss is one the main foods of the carabou and reindeer, it might appear advisable to plant reindeer on some of these islands having an abundant supply of this lichen. However, after considering the ruggedness of some of these islands, which would discourage hunting of these animals; the habits of the Aleuts living on the islands, who prefer the shoreline to the interior; it is quite obvious that the presence of reindeer on these islands would not be of material benefit to them. These statements have already been shown as facts on Atka Island.

(M_{17}) Sedge and Rush: The sedge and rush type usually dominated by the sedges were often found marginal to ponds and small lakes and in the slightly depressed and level areas in the larger valleys.

Sedges common in this type are Carex macrochaeta, C. physocarpa (?), C. rariflora, and C. lyngbyei. Of the Juncaceae, Luzula multiflora was very prominent and in some cases the dominant specie of this type. A conspicuous flowering plant associated with this type is Caltha palustrus var. assarifolia.

(M_{25}) Sphagnum Bog: Sphagnum bog is not a common plant cover type. Localized spots of Sphagnum growing with other mosses are present on most of the islands, but they were too small to map. However, Kanaga Island had larger beds of sphagnum.

(H_1) Mix: Mix up the vegetation of two though usually three or more of the plant types previously discussed under Vegetation in the Interior and general ideas can be had on the nature of this type of vegetation. To discuss the type further would result in more confusing mixup.

(W_1) Sago Pondweed Type: The sago pondweed type included Potamogeton filiformis (?) or other species closely related to Potamogeton pectinatus. This is not a common aquatic type. Infact, it was found extensively enough to map only on one lake on Kanaga Island.

For the most part inland fresh water lakes and ponds of the Aleutian islands lacked aquatic vegetation.

Water Analysis

Water samples were collected for several lakes and ponds, on the Aleutian Islands, and fixed or bound carbon dioxide tests were made.

We are indebted to Doctor J. S. Bordner, Director of the Wisconsin Land Inventory for equipment and solutions for making fixed CO_2 tests.

Fixed CO_2 Tests of Water Samples
Aleutian Islands

Location	Date of Collection	Date of Test	Parts per million fixed CO_2
Umnak Island Lake by Unmak Village	8-24-37	1-10-38	13.5
Agattu Island Lake in East End	6-12-37	1-10-38	8.5
Agattu Island Lake in East Central Part	6-12-37	1-10-38	2.9
Kiska Island Lake in South End	6-21-37	1-10-38	12.35
Kavalga Island Lake	7-29-37	1-10-38	23.75
Atka Island Lake	8-13-37	1-10-38	33.9
Amchitka Island Lake	7-19-37	1-10-38	36.0
Rat Island Lake in West End	6-30-37	1-10-38	4.25
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Unalaska Island Lake	8-25-37	1-11-38	11.5

Determination of the hardness and softness of water from fixed CO_2 is more dependable than Ph determination because the Ph would be variable since it measures the hydrogen ion concentration. The hydrogen ion concentration varies because of the photosynthesis of phyto-plankton and other plant life.

These tests tend to show that the water of inland lakes and ponds of the Aleutian islands are, for the most part, soft and undoubtedly lack mineral nutrients needed for a luxurient growth of aquatic plants and other life.

Exceptions were found on lakes at Atka and Amchetka islands.

In these lakes Myriophyllum spicatum, Ranunculus trichophyllus, and some Potamogeton spp. were found growing in dense beds.

Marine Plants

Zosteria marina was found on Sanak Island. Though some of the marine algae were collected no intensive studies were made of these kelps.

Unfinished Work on Aleutian Report

Doctor Eric Hulten's recent paper Flora of the Aleutians, will furnish valuable information on plant distribution. Notes on plant distribution from our expedition will be added to this report when all the collection sent to the Biological Survey in Washington, D. C. has been identified.

Some time in the near future seed and fruit collections will be identified, labeled, and sent in.

Negatives of photographs that I took on the trip have not been catalogued and labled.

North Dakota Refuges and Medicine Lake, Montana

Forestry programs have been drawn up by refuge personnel for all refuges.

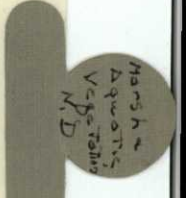
Marsh and aquatic programs have been drawn up for Arrowwood Refuge and Medicine Lake Refuge by refuge managers. A general report has been prepared to serve as a guide for marsh and aquatic planting.

PRELIMINARY NOTES ON MARSH AND AQUATIC VEGETATION NORTH DAKOTA

During the past three years we have all been engaged in part in guiding and hurrying Nature in furnishing refuges with desirable marsh and aquatic vegetation. Various methods of planting have been used with varied success.

On the basis of the work done in our district and elsewhere, an attempt is being made to describe some of the more desirable marsh and aquatic plants with reference to specie, value, environmental requirements, and propagation for refuges of our locality. Information on propagation of these plants is shown in a chart at the conclusion of this report.

This accumulative information given in this memo is not complete, since this field is relatively new. Continued work on marsh and aquatic vegetation will lead to other information which will be of value to all of us in doing this work in the future.



Pondweeds
(Najadaceae)

Species: Of the pondweeds found in this district Sago pondweed (Potamogeton pectinatus), leafy pondweed (P. foliosus), redhead grass or clasping leafed pondweed (P. perfoliatus var. richardsonii) and wigeon grass (Ruppia maritima), are most important.

Since these plants have similar characteristics they will be discussed as a group.

Value: All these plants, particularly Sago pondweed and redhead grass are well known duck foods and little need be added on this subject.

However, there is another point of particular significance to consider. Field observations tend to show that areas, where there are large beds of aquatic plants, are not inflicted with western duck sickness or botulism.

The causative organism for this malady is the bacteria Clostidium botulinium type C, which secretes the virulent fatal toxin that has killed ducks. This bacteria is an anaerobe and consequently can not exist in the presence of free oxygen. On the other hand aquatic chlorophyll bearing plants produce free oxygen by their photosynthetic processess and consequently appear to cause a non-desirable environment for anaerobic life. In other words the presence of green aquatic plants purify the water so that a serious botulistic condition will not develop. These statements with reference to botulism and aquatic plants should be regarded as a supposition and not as facts, since I do not know of any experimental work done on this subject.

Environmental Requirements: It is obvious that these plants grow only in water, nevertheless they appear to be able to live over in those places that become dry during the fall. This is due to the fact that sufficient norishment is stored in the rootstocks and tuberb.

These aquatic plants, particularly wigeon grass and sago pondweed can grow in fairly brackish waters.

Aquatic vegetation cannot thrive in badly roiled waters. Anyone who has observed ox-bows of streams with a heavy growth of water plant life as compared to streams with out plant life would readily note this characteristic of aquatic vegetation. The significance of these statements were further proven by a series of experimental plot studies made in the Des Lacs Refuge in 1936.

In view of these facts it is obvious that a badly roiled water condition must be corrected before doing aquatic planting.

Judging from field observations made on the Upper Souris and Arrowwood refuges it appears that a green scum or bloom due to plankton and other algae are not so detrimental to the growth of aquatic plants as roiled water.

Water Plantains
(Alismaneae)

Species: Of the Water Plantain Family, the Sagittarias, particularly duck potato (Sagittaria latifolia) is of some significance.

Value: There has been a lot of talk praising this plant as a duck food. For the most part, it has been over done. This is probably due to the fact that the closely related delta potato (Sagittaria plytyphylla) which is of great value as a duck food in the southern states. However, this plant like other marsh vegetation aids in preventing roiled waters when planted marginal to the water.

Environmental Requirements: This plant grows marginal to the water and in the water to about 10" in depth. It is not so lenient in brackish water as other vegetation.

Marsh Grasses
(Gramineae)

Species: Of the many desirable species of marsh grasses, we will limit ourselves to the 3 species, wild millet (Echinochloa crusgalli), wild rice (Zizania aquatica), and cord grass (Spartina michauxiana).

Wild Millet

Value: Wild millet has a two point value for food and cover. Both the grass sprouts and the seeds are desired by geese and ducks. When planted marginal to the water it will aid in preventing the water from becoming muddy due to wave action. Environmental Requirements: Wild millet an annual requires a saturated to near saturated condition for germination and initial growth. After that it can stand varied conditions. The seed is known to hold life even if it lays over for 2 years or more. It will grow in fresh to fairly brakish water

Wild Rice

Value: Wild rice has often been acclaimed as one of our most valuable food cover plants for waterfowl.

Environmental Requirements: Wild rice has definite requirements that must receive consideration if satisfactory results are to be obtained.

(1) It will grow in fresh to slightly brackish water.
(2) An exchange of water through all or part of the season is desired.
(3) Depth for planting is 6" to 36", 12" to 24" being most desirable.
(4) Bottom soil having a layer or covering of partly broken down dead vegetation is desirable for sowing rice seed. For example, wild rice very readily reseeds itself in its own partly decayed straw. In 1936 on the Des Lacs Refuge a good catch was made in a flooded field that was covered with remains of Russian Thistle. At Lower Souris Refuge wild rice planted in locations marginal to heavy vegetation where plant remains tended to form cover on the bottom, was successful. This particular requirement for wild rice appears necessary so that this bristled awned seed will be able to work its way down so that it will not be so readily found by waterfowl. Some believe that a buried condition is necessary for a proper germination of the seed.

(5) One of the most important and least considered environmental requirement of wild rice is that of a constant water level. It was known to stand a slow drop in water level but has again and again proven that it will not live where there are sudden changes in water level even of 5 or 6 inches. This fact was brought out at the Lower Souris Refuge during 1937 and is an old story in the extensive rice beds of the Great Lakes States.

In view of these facts it is absolutely essential to have a controlled constant water supply during the growing season if satisfactory results from planting wild rice are desired.

Cord Grass

Value: Nesting studies at Lower Souris Refuge revealed that cord grass was one of the most desirable cover plants for nesting waterfowl. The ability of the stalk and leaf-remains of this plant to stand up during winter and early spring furnished desired early season cover.

This plant is of particular significance in furnishing our small nesting islands with desirable cover. The extensive rhizomb and root growth will tend to hold and build up the soil on these islands and thus insure their permanency.

Environmental Requirements: This plant is very hardy. It will live under drouth conditions and is known to thrive in 12" depths of water. Varied water levels will not effect it; in fact, field observations show that sudden changes from aquatic to dry and back to aquatic condition during one season does not bother this plant.

Rushes
(Of the Cyperaceae)

Spiked Rushes

Species: Of the two spiked rushes in our district, common spiked rush (Eleocharis palustrus) and the slender or needle spiked rush (Eleocharis acicularis), ~~slender spiked rush~~ deserves special consideration.

Value: This minute slender spiked rush growing in dense mat was observed to be grazed on by baldpate and to a lesser extent by the gadwell.

The presence of a rhizomb spreading mat growth of this plant would be of particular significance on water filmed mud flats where a botulistic condition is liable to develop. Extensive planting of this plant is limited since, though common, it is not found in abundant quantities.

Spiked Rushes
(continued)

Environmental Requirements: Environmental requirements of this plant further add to its value since it has been observed to thrive in spite of varied water conditions, whether it be submerged or on dry mud flats.

Bulrushes

Species: Of the several bulrushes in our area the hardstem bulrush (Scirpus acutus) and prairie bulrush (Scirpus paludosus) are the most important in our marsh planting work.

Value: Both these bulrushes are desirable for furnishing cover, and prairie bulrush appears to be of particular significance as a food plant.

Another valuable asset of these rushes is their ability to prevent roiled water due to wave action when marginal to the shore. A lack of roiled water results in a suitable environment for aquatic plants. The presence of such marsh and aquatic vegetation plus a lack of bare mud flats will result in an environment not so suitable for botulism.

Prairie bulrush is of particular importance because it will spread more readily than the hardstem bulrush and can grow in more brackish waters.

Dense beds of bulrushes, particularly hardstem bulrush can be improved forwaterfowl, such as the diving-duck, by digging root-stocks for transplanting along meandering channels 10 to 20 feet wide. For example, canvasbacks nested in bulrushes marginal to such channels on the Lower Des Lacs Lake for the first time in 11 years in 1936.

The tendency of hardstem bulrush to grow a rip-rap of rhizombs that effectively resist erosion will insure the presence of small islands and will protect the more exposed parts of the larger islands.

Environmental Requirements: Hardstem bulrush grows in fresh to fairly brackish water from slightly above water level to about 3 feet below water level.

Prairie bulrush grows in fairly fresh to brackish water from slightly above water level to 18" below water level.

Both species seem able to survive a certain amount of water fluctuation.

Smartweed
(Of the Polygonaceae)

Species: Two smartweeds of particular importance in our district are pale smartweed, (Polygonum lapathifolium) and swamp or marsh smartweed (P. muhlenbergii).

Value: Both these smartweeds are excellent foods for waterfowl, and also good cover during summer and fall.

Swamp smartweed is of particular benefit because of its ability to live in varied water levels and to follow up receeding water levels. Originally many of the sloughs of the prairie region that were so much desired by waterfowl were surrounded partly if not entirely by this smartweed. The encroaching of this plant on this margin is not desirable for a botulistic condition. ?

Environmental Requirements for Pale Smartweed: Pale smartweed grows in marsh to mesophyte condition. It is desirable to plant marginal to water but not in water.

Plant Propagation

Conclusion on method for planting marsh and aquatic plants is taken from the results of previous planting by Biological Survey personnel in our district and also of others who have done work on plant propagation of species mentioned in this report. On the following chart on plant propagation the (*) have not been sufficiently tried out to warrant satisfaction.

CHART ON PLANT PROPAGATION

Specie	Reproductive part	Method of Storage	Date for planting	Method of Planting
Sago Pondweed (Potamogeton pectinatus).	Seeds ?	Cold water storage in winter, Cold damp storage in plant remains or like substance during winter.	Spring break-up to July 1	Rake in just before flooding Clay balls, depth of 6-36".
	Tubers	Cold water storage Cold damp storage in straw or like substance.	Same	Pressing into bottom mud, Clay balls, depth of 6 - 36".
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud, or by using clay balls.
Redhead grass (P. obtusiffolius)	Same as above	Same as above	Same as above	Same as above
Leafy Pondweed (P. foliosus)	Seeds	Cold water storage in winter. ?	Spring break-up to July 1	Rake in just before flooding Clay balls at depth of 6-36"
	Root-stocks	Cold water storage or damp storage in * straw or like substance.	Same as above.	Press in bottom mud Clay balls at depth of 6-36"
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud or Clay balls depth 6-36".
Wigeon Grass (Ruppia maritima)	Seeds *	Cold water storage Damp storage in straw or like substance.	Spring break-up to July 1	Soak seed until it sinks, then broadcast, depth 6-36".
	Root- * stocks	Same as above	same as above	Press in bottom mud, or Clay balls, depth 6-36".
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clump of 4-6 leafy stems pressed in bottom mud or by using clay balls depth 6-36".
Duck potato (Sagittaria latifolia)	Seeds (Not dependable)	Cold water storage in winter. ?	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
	Tubers	Cold water storage during winter, cold damp storage in straw or like substance.	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
Wild Millet (Echinochloa crus-gallii)	Seed	Dry storage	Spring break-up to July 1	Sow or drill.
Wild Rice (Zizanai aquatica)	Seed	Keep moist and plant immediately. Cold storage during winter.	Sept. to period of freeze-up & Spring break-up to June 1	Sow in water, depth 6-36 ".
Cord grass (Spartina michauxiana)	Root-stocks	*Damp storage during winter, * Transplant directly.	Spring break-up to(*) Aug.	Press in or cover with thin layer of soil.
Needle rush (Eleocharis acicularis)	Whole plant	*Keep moist * Damp storage during winter.	Spring break-up to Sept. 1	Slightly above water level.
Hardstem bulrush (Scirpus acutus)	Root-stocks or whole plant.	Left in piles with dirt left on. Damp cold storage, cold water storage, during winter.	Spring break-up to Freeze-up	Press in bottom soil at water level to 3 feet below water level. Best results from spring to summer planting.
Prairie bulrush (S. pallidosus)	Tubor or whole plant	Piled outside and covered with dirt and straw. Damp cold storage, water storage during winter.	Spring break-up to freeze-up	Press in bottom soil at water level to 18" below water level.
Pale smartweed (Polygonum lapathifolium)	Seed	Dry storage (Grows best mixed with wild millet).	Spring break-up to June 15	Drill or sow and rake in at depth of slightly above water level to water level.
Swamp smartweed (P. muhlenbergii)	Seed	As yet have not heard of satisfactory results from seed planting.		
	Whole plant Stem or cuttings in lower part of stem at least 2 nodes.	Water storage several days 2	June 15 to Aug. 15	Anchor bottom so that there is 2-12" of water over top part of stem which must remain under water till it sprouts.
		Cold water storage during winter for stem cuttings.	Spring break-up to June 1	Same as above.

Des Lacs Refuge

Dams: Approval of dam projects for impounding water for nesting waterfowl and botulism control is pending.

Ditching: The propose ditching in pondsite #2 which was previously favorably commented on by Mr. Kubichek during his visit last fall and certainly deserves consideration, was disapproved as a C.C.C. pfoject.

Tree and Shrub Planting: A tree and shrub planting program drawn up by Mr. Low as a result of a conference with Mr. Larson and myself was returned. This program will be altered to confoom with the proposals as outline by the Washington and regional office.

S.F.

Aleutian Islands
North Dakota

NARRATIVE REPORT OF ACTIVITIES
FEBUARY 1938

Copy of Monthly narrative Report for Mr Kubichek

Duplicate copy

Reference made
Botulism control by planting aquatics

The underlined needs attention

Submitted by.
John Steen

NARRATIVE REPORT OF ACTIVITIES
FEBRUARY 1938

Aleutian Island Report

There has been such a rush to get work programs of a biological nature lined up for refuges of this district that time had to be deliberately taken out to complete my contribution to the Aleutian Island report.

While on the Aleutian Expedition it was agreed upon that Mr. O. J. Murie, chief of our party, would work up the report. Each one of our party was to work on a contribution to this report dealing with some phase of the field work. Mr. Douglas Gray, of the Alaskan Game Commissioner, contributed information on human relations with reference to future administration. Mr. Murie's problem, aside from compiling the report, was on bird and animal life. Doctor V. Scheffer contributed on marine and invertebrate life with particular reference to food habits. My problem dealt with the vegetation.

During the expedition we collected and gathered data on all phases of the work and were continuously involved in roundhouse discussions on various phases of this project. Information and collections on different phases of the work has been turned over to the person working up this phase of the work.

Since the completion of our expedition the following have added more information particularly on nomenclature of plants: Messrs. J. P. Anderson, Eric Hulten, Neal Hotchkiss, W. R. Maxon, J. R. Swallen, S. F. Blake, and H. C. Fassett.

Flora of the Aleutian Islands

The flora of the Aleutian Islands can be characterized as northern prairie or tundra because the vegetation of these islands is beyond the treeline. This is a rather striking feature in view of the fact that Anatigmak, the most southern of this chain of islands is quoted to be two miles north of London, England.

This arctic treeless condition of the islands is probable due to several factors of which the temperature and the nature of the soil are worth considering. Since the temperature of the Pacific Ocean and the Bering Sea that surround these islands remains on or about 42°F., the temperature of the islands range from slightly below freezing to slightly above 50°F. It is also probable that the raw condition of the soil due to its recent origin which, on being associated with other undesirable factors, also has much to do with the lack of trees.

Vegetative Cover Type Maps

An attempt has been made to explain and describe the nature of the flora on these islands by making a cover type map of the vegetation on a part of Kanaga and Igitkin islands. Plots chosen for mapping had plant associations that were typical of the Aleutians, particularly those islands west of Umalaska. We are indebted to Mr. J. Tise, Assistant Technician CCC Camp BF-3, Kenmare, North Dakota for making finished copies of the original field maps.

The determination of the vegetative types was not placed entirely on an ecological basis. A definite understanding of plant ecology on the island did not seem possible and it was a relief to read Doctor R. Griggs' paper on The Problem of Arctic Vegetation. *

> He states, "Finally, however, I came to see the trouble. These northern vegetation types stand lower in the plant succession than any of the natural associations in the south. When I began to compare them with ephemeral weed vegetation of cultivated fields, a comprehension of arctic ecology began at once to dawn on me.
>
> Go out to one of the numerous real estate developments where they have made over the landscape recently and try to classify the weeds that appear. Cataloging the plants over several such developments, you will make a long list of familiar weeds. Now try to classify them as to habitat preference and their associations to each other." *

These statements appear to fit plant ecology on the Aleutian Islands in a nut shell.

The description of these types is general in that they were made to describe the different vegetative types for this chain of islands and not for the specific cover types as mapped on Igitkin and Kanaga islands. The dominant and some of the subdominant species are mentioned in the following description on plant types.

Classification of symbols for vegetative cover types follows the plan for Vegetative Classification for Cover Mapping as presented by the Migratory Waterfowl and Wildlife Research divisions.

* Griggs, Robert F.
1934, Problem of Arctic Vegetation
Journal of the Washington Academy of Sciences, Vol. 24, page 168.

Outer Belt of Vegetation

(G.) Large Grass Type: One of the most notable and striking features of the Aleutian Islands is the marginal belt of Elymus mollis dominant type of vegetation which often extends well up the slopes of mountains and back along flats just off the beach. Subdominant plants worthy of note of this type are the two species of the Umbelliferae, Ligusticum scothicum and Conioselinum gmelini, and a specie of the Compositae, Senecio pseudo-arnica. Immediately marginal to the beach Honckenya peploides var. major. (Arenaria peploides) is invarably found.

This rank heavy growth hip to shoulder high with its tendency to grow in clumps is a definite impediment to walking. Nevertheless, the extensive rhizomb fibrous root growth and the tough fibered nature of the leaf blades and stems could be relied upon for aid in climbing almost perpendicular slopes.

This marginal belt of prominent vegetation had a distinct bearing on wild life. On nobs, chimneys, protruding cliffs and shelves covered with this rank plant growth, the bald headed eagle finds suitable nesting sites. This luxurious growth of vegetation also furnishes suitable nesting cover for the Pacific eider and the glaucous winged gull. Burroughing birds, particularly the tufted puffin, have formed honeycomb colonies for nesting, particularly in those places where the fox do not interfere. Foxes were also observed to have their dens (in part) in this outer belt of rank vegetation.

Vegetation in the Interior

The plant life inward from this outer growth of rank luxurious vegetation appeared to follow no ecological pattern. To be sure aquatics were found in the fresh water pools and lakes. Sedges were found in the more wet habitats, but never the less could be found anywhere. Generally speaking, there appeared to be a grand mix up of plants apparently lacking characteristics which would allow segregation of this vegetation into definite plant associations.

Often there was a dominance of certain plant species with apparently no ecological reason. On Kiska Island particularly in the southern part, reindeer moss (Cladonia spp.) was dominant. On a large part of Umnak Island grasses were dominant (not the large Elymus mollis). On many islands the crowberry (Empetrum nigrum) was dominant, and on other islands there were mixtures of plants peeviously mentioned as well as other tundra species that it is very convenient to refer to such vegetative cover as mix.

In the interior regions of these islands humps or miniature moors of peat 3 to 4 feet high are sometimes common. In some cases it appears that this condition is due to an accumulative growth of moss particularly club moss (Polytrichum spp. or closely related species) and Sphagnum. These small peaty hummocks often serve as places of rest and observation for the parasitic jaeger, the glaucous-winged gull, the baldheaded eagle, and the blue fox.

This inner area of vegetation does not appear to be so significant as the outer belt of vegetation for bird and animal life. Waterfowl, particularly the European teal, the greater scaup, red-throated loon, Aleutian sandpiper, and northern phalarope find suitable nesting sites in the vicinity of fresh water ponds and lakes. Apparently rock ptarmigan found suitable nesting sites in this range of vegetation. For the most part the smaller birds, the Alaskan longspur, the Aleutian song sparrow(?) the snow bunting, and on the islands to the eastwork the Savannah sparrow, and the American pipit also found suitable nesting sites in this region of plant life. The birds mentioned above were not so numerous or concentrated as the sea birds observed marginal and on the shores of these islands. To be sure there were concentrated colonies of auklets in the interior, particularly on Semisopochnoi Island but this was not due to the vegetation but rather to extensive cavities and pockets resulting from a jumbled mix up of cliff like rock and boulders that were the result of the blowing up of a volcanic mountian during the past. These cavaties and pockets furnished ideal nesting sites for the auklets.

Vegetative cover types for plant life in the interior of these islands are: (B_1) Heath, (B_2) Alpine heaths, (G_2) Small Grass, (L_2) Cladonia, (M_{17}) Sedges and Rushes, (M_{25}) Sphagnum Bog, and (W_1) Sago pondweed.

(B_1) Heaths: The heath type of vegetation could be more correctly called the Empetrum nigrum (of the Empetaceae) type. Other heaths (of the Ericaceae) often prominent in this type are Phyllodoce glanduliflora and Vaccinium vitis-idaea. Grass species often found growing with these heaths are Festuca rubra, and Calamagrostis canadensis var. scabra.

(B_2) Alpine Heaths: Alpine heath type was similar to the one discussed above. However, Empetrum nigrum is very dwarfed and invariably associated with Loiseleria procumbens. Cassiope hypnoides is also found growing in the higher more exposed habitats. No grasses were prominent in this alpine type.

(C_2) Small Grass: This small grass type is distinctly different from the (C_1) large grass type in that the large rank growth of Elymus mollis is not included in this type. The following in mixed or pure stand are the dominant species of Graminia usually found in this type: Festuca rubra, Poa artica, Calamagrostris canadensis var scabra, Agrostis borealis, Deschampsia caespitosa var. artica, and Puccinellia pumila.

Sedges particularly Carex rariflora are often found in this grass type.

Though the more conspicuous flowering plants were found in most of the types, they appear to be more noticeable in this smaller grass type. Some of the flowering plants worthy of note are: Frittilaria camschatcensus, Orchis aristata, Plantasthera spp., Anemone narcissiflora, Ranunculus nelsonii, Lupinus nootkatensis, Geranium erianthum, Chrysanthemum articum, Ericeron peregrinus, and Arnica sp.

From the standpoint of land use, extensive areas covered with a small grass dominant type have already shown themselves of valuable significance for the raising of sheep. On Umnak Island a sheep ranch has been very successful, and the wool shipped out is reported to be of a superior quality.

(L_1) Cladonia: The reindeer moss type (Cladonia spp. & lichens) is often associated with subdominant moss species (Species of Musci) and some of the grasses previously mentioned. In more moist areas sedges (Carex sp.) were observed to be associated in this lichen.

In view of the fact that reindeer moss is one the main foods of the carabou and reindeer, it might appear advisable to plant reindeer on some of these islands having an abundant supply of this lichen. However, after considering the ruggedness of some of these islands, which would discourage hunting of these animals; the habits of the Aleuts living on the islands, who prefer the shoreline to the interior; it is quite obvious that the presence of reindeer on these islands would not be of material benefit to them. These statements have already been shown as facts on Atka Island.

(M_{17}) Sedge and Rush: The sedge and rush type usually dominated by the sedges were often found marginal to ponds and small lakes and in the slightly depressed and level areas in the larger valleys.

Sedges common in this type are Carex macrochaeta, C. physocarpa (?), C. ratiflora, and C. lyngbyei. Of the Juncaceae, Luzula multiflora was very prominent and in some cases the dominant specie of this type. A conspicuous flowering plant associated with this type is Caltha palustrus var. asarifolia.

(M_{25}) Sphagnum Bog: Sphagnum bog is not a common plant cover type. Localized spots of Sphagnum growing with other mosses are present on most of the islands, but they were too small to map. However, Kanaga Island had larger beds of sphagnum.

(H_1) Mix: Mix up the vegetation of two though usually three or more of the plant types previously discussed under Vegetation in the Interior and general ideas can be had on the nature of this type of vegetation. To discuss the type further would result in more confusing mixup.

(W_1) Sago Pondweed Type: The sago pondweed type included Potamogeton filiformis (?) or other species closely related to Potamogeton pectinatus. This is not a common aquatic type. In fact, it was found extensively enough to map only on one lake on Kanaga Island.

For the most part inland fresh water lakes and ponds of the Aleutian islands lacked aquatic vegetation.

Water Analysis

Water samples were collected for several lakes and ponds, on the Aleutian Islands, and fixed or bound carbon dioxide tests were made.

We are indebted to Doctor J. S. Bordner, Director of the Wisconsin Land Inventory for equipment and solutions for making fixed CO_2 tests.

Fixed CO_2 Tests of Water Samples Aleutian Islands

Location	Date of Collection	Date of Test	Parts per million fixed CO_2
Unmak Island Lake by Unmak Village	8-24-37	1-10-38	13.5
Agattu Island Lake in East End	6-12-37	1-10-38	8.5
Agattu Island Lake in East Central Part	6-12-37	1-10-38	2.9
Kiska Island Lake in South End	6-21-37	1-10-38	12.35
Kavalga Island Lake	7-29-37	1-10-38	23.75
Atka Island Lake	8-13-37	1-10-38	33.9
Amchitka Island Lake	7-19-37	1-10-38	36.0
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Determination of the hardness and softness of water from fixed CO_2 is more dependable than Ph determination because the Ph would be variable since it measures the hydrogen ion concentration. The hydrogen ion concentration varies because of the photosynthesis of phyto-plankton and other plant life.

These tests tend to show that the water of inland lakes and ponds of the Aleutian islands are, for the most part, soft and undoubtedly lack mineral nutrients needed for a luxurient growth of aquatic plants and other life.

Exceptions were found on lakes at Atka and Amchetka islands.

In these lakes Myriophyllum spicatum, Ranunculus trichophyllus, and some Potamogeton spp. were found growing in dense beds.

Marine Plants

Zostoria marina was found on Sanak Island. Though some of the marine algae were collected, no intensive studies were made of these kelps.

Unfinished Work on Aleutian Report

Doctor Eric Hulten's recent paper Flora of the Aleutians, will furnish valuable information on plant distribution. Notes on plant distribution from our expedition will be added to this report when all the collection sent to the Biological Survey in Washington, D. C. has been identified.

Some time in the near future seed and fruit collections will be identified, labled, and sent in.

Negatives of photographs that I took on the trip have not been catalogued and labled.

North Dakota Refuges and Medicine Lake, Montana

Forestry programs have been drawn up by refuge personnel for all refuges.

Marsh and aquatic programs have been drawn up for Arrowwood Refuge and Medicine Lake Refuge by refuge managers. A general report has been prepared to serve as a guide for marsh and aquatic planting.

PRELIMINARY NOTES ON MARSH AND AQUATIC VEGETATION NORTH DAKOTA

During the past three years we have all been engaged in part in guiding and hurrying Nature in furnishing refuges with desirable marsh and aquatic vegetation. Various methods of planting have been used with varied success.

On the basis of the work done in our district and elsewhere, an attempt is being made to describe some of the more desirable marsh and aquatic plants with reference to species, value, environmental requirements, and propagation for refuges of our locality. Information on propagation of these plants is shown in a chart at the conclusion of this report.

This accumulative information given in this memo is not complete, since this field is relatively new. Continued work on marsh and aquatic vegetation will lead to other information which will be of value to all of us in doing this work in the future.

Pondweeds
(Naiadaceae)

Species: Of the pondweeds found in this district Sago pondweed (Potamogeton pectinatus), leafy pondweed (P. foliosus), redhead grass or clasping leafed pondweed (P. perfoliatus var. richardsonii) and wigeon grass (Ruppia maritima), are most important.

Since these plants have similar characteristics they will be discussed as a group.

Value: All these plants, particularly Sago pondweed and redhead grass are well known duck foods and little need be added on this subject.

However, there is another point of particular significance to consider. Field observations tend to show that areas, where there are large beds of aquatic plants, are not inflicted with western duck sickness or botulism.

The causative organism for this malady is the bacteria Clostidium botulinium type C, which secretes the virulent fatal toxin that has killed ducks. This bacteria is an anaerobe and consequently can not exist in the presence of free oxygen. On the other hand aquatic chloraphyll bearing plants produce free oxygen by their photosynthetic processess and consequently appear to cause a non-desirable environment for anaerobic life. In other words the presence of green aquatic plants purify the water so that a serious botulistic condition will not develop. These statements with reference to botulism and aquatic plants should be regarded as a supposition and not as facts, since I do not know of any experimental work done on this subject.

Environmental Requirements: It is obvious that these plants grow only in water, nevertheless they appear to be able to live over in those places that becomes dry during the fall. This is due to the fact that sufficient norishment is stored in the rootstocks and turborb.

These aquatic plants, particularly wigeon grass and sago pondweed can grow in fairly brackish waters.

Aquatic vegetation cannot thrive in badly roiled waters. Anyone who has observed ox-bows of streams with a heavy growth of water plant life as compared to streams with out plant life would readily note this characteristic of aquatic vegetation. The significance of these statements were further proven by a series of experimental plot studies made in the Des Lacs Refuge in 1936.

In view of these facts it is obvious that a badly roiled water condition must be corrected before doing aquatic planting.

Judging from field observations made on the Upper Souris and Arrowwood refuges it appears that a green scum or bloom due to plankton and other algae are not so detrimental to the growth of aquatic plants as roiled water.

Water Plantains
(Alismaneae)

Species: Of the Water Plantain Family, the Sagittarias, particularly duck potato (Sagittaria latifolia) is of some significance.

Value: There has been a lot of talk praising this plant as a duck food. For the most part, it has been over done. This is probably due to the fact that the closely related delta potato (Sagittaria platyphylla) which is of great value as a duck food in the southern states. However, this plant like other marsh vegetation aids in preventing roiled waters when planted marginal to the water.

Environmental Requirements: This plant grows marginal to the water and in the water to about 10" in depth. It is not so lenient in brackish water as other vegetation.

Marsh Grasses
(Gramineae)

Species: Of the many desirable species of marsh grasses, we will limit ourselves to the 3 species, wild millet (Echinochloa crusgalli), wild rice (Zizania aquatica), and cord grass (Spartina michauxiana).

Wild Millet

Wild Rice

Value: Wild rice has often been acclaimed as one of our most valuable food cover plants for waterfowl.

Environmental Requirements: Wild rice has definite requirements that must receive consideration if satisfactory results are to be obtained.

(1) It will grow in fresh to slightly brackish water.
(2) An exchange of water through all or part of the season is desired.
(3) Depth for planting is 6" to 36", 12" to 24" being most desirable.
(4) Bottom soil having a layer or covering of partly broken down dead vegetation is desirable for sowing rice seed. For example, wild rice very readily reseeds itself in its partly decayed straw. In 1936 on the Des Lacs Refuge a good catch was made in a flooded field that was covered with remains of Russian Thistle. At Lower Souris Refuge wild rice planted in locations marginal to heavy vegetation where plant remains tended to form cover on the bottom, was successful. This particular requirement for wild rice appears necessary so that this bristled awned seed will be able to work its way down so that it will not be so readily found by waterfowl. Some believe that a buried condition is necessary for a proper germination of the seed.

Wild Millet

Value: Wild millet has a two fold value, for food and cover. Both the grass sprouts and the seeds are desired by geese and ducks. When planted marginal to the water it will aid in preventing the water becoming muddy due to wave action.

Environmental Requirements: Wild millet, an annual, requires a substrate to be saturated to near submerged condition for germination and initial growth. After this it can stand varied conditions. The seed is known to hold life even if it lays over for years. It will grow in fresh to fairly brackish water.

(5) One of the mostiimportant and least considered environmental requirement of wild rice is that of a constant water level. It was known to stand a slow drop in water level but has again and again proven that it will not live where there are sudden changes in water level even of 5 or 6 inches. This fact was brought out at the Lower Souris Refuge during 1937 and is an old story in the extensive rice bedsbf the Great Lakes States.

In view of these facts it is absolutely essential to have a controlled constant water supply during the growing season if satisfactory results from planting wild rice are desired.

Cord Grass

Value: Nesting studies at Lower Souris Refuge revealed that cord grass was one of the most desirable cover plants for nesting waterfowl. The ability of the stalk and leaf-remains of this plant to stand up during winter and early spring furnished desired early season cover.

This plant is of particular significance in furnishing our small nesting islands with desirable cover. The extensive rhizomb and root growth will tend to hold and build up the soil on these islands and thus insure their permanency.

Environmental Requirements: This plant is very hardy. It will live under drouth conditions and is known to thrive in 12" depths of water. Varied water levels will not effect it; in fact, field observations show that sudden changes from aquatic to dry and back to aquatic condition during one season does not bother this plant.

Rushes
(Of the Cyperaceae)

Spiked Rushes

Species: Of the two spiked rushes in our district, common spiked rush (Eleocharis palustrus) and the slender or needle spiked rush (Eleocharis acicularis), slender spiked rush deserves special consideration.

Value: This minute slender spiked rush growing in dense mat was observed to be grazed on by baldpate and to a lesser extent by the gadwall.

The presence of a rhizomb spreading mat growth of this plant would beof particular significance on water filmed mud flats where a botulistic condition is liable to develop. Extensive planting of this plant is limited since, though common, it is not found in abundant quantities.

Spiked Rushes
(continued)

Environmental Requirements: Environmental requirements of this plant further add to its value since it has been observed to thrive in spite of varied water conditions, whether it be submerged or on dry mud flats.

Bulrushes

Species: Of the several bulrushes in our area the hardstem bulrush (Scirpus acutus) and prairie bulrush (Scirpus pallidosus) are the most important in our marsh planting work.

Value: Both these bulrushes are desirable for furnishing cover, and prairie bulrush appears to be of particular significance as a food plant.

Another valuable asset of these rushes is their ability to prevent roiled water due to wave action when marginal to the shore. A lack of roiled water results in a suitable environment for aquatic plants. The presence of such marsh and aquatic vegetation plus a lack of bare mud flats will result in an environment not so suitable for botulism.

Prairie bulrush is of particular importance because it will spread more readily than the hardstem bulrush and can grow in more brackish waters.

Dense beds of bulrushes, particularly hardstem bulrush can be improved for waterfowl, such as the diving-duck, by digging root-stocks for transplanting along meandering channels 10 to 20 feet wide. For example, canvasbacks nested in bulrushes marginal to such channels on the Lower Des Lacs Lake for the first time in 11 years in 1936.

The tendency of hardstem bulrush to grow a rip-rap of rhizomes that effectively resist erosion will insure the presence of small islands and will protect the more exposed parts of the larger islands.

Environmental Requirements: Hardstem bulrush grows in fresh to fairly brackish water from slightly above water level to about 3 feet below water level.

Prairie bulrush grows in fairly fresh to brackish water from slightly above water level to 18" below water level.

Both species seem able to survive a certain amount of water fluctuation.

Smartweed
(Of the Polygonaceae)

Species: Two smartweeds of particular importance in our district are pale smartweed, (Polygonum lapathifolium) and swamp or marsh smartweed (P. muhlenbergii).

Value: Both these smartweeds are excellent foods for waterfowl, and also good cover during summer and fall.

Swamp smartweed is of particular benefit because of its ability to live in varied water levels and to follow up receeding water levels. Originally many of the sloughs of the prairie region that were so much desired by waterfowl were surrounded partly if not entirely by this smartweed. The encroaching of this plant on this margin is not desirable for a botulistic condition.

Environmental Requirements for Pale Smartweed: Pale smartweed grows in marsh to mesophyte conditions. It is desirable to plant marginal to water but not in water.

Plant Propagation

Conclusion on method for planting marsh and aquatic plants is taken from the results of previous planting by Biological Survey personnel in our district and also of others who have done work on plant propagation of species mentioned in this report. On the following chart on plant propagation the (*) have not been sufficiently tried out to warrant satisfaction.

CHART ON PLANT PROPAGATION

Specie	Reproductive part	Method of Storage	Date for planting	Method of Planting
Sago Pondweed (Potamogeton pectinatus)	Seeds	Cold water storage in winter, Cold damp storage in plant remains or like substance during winter.	Spring break-up to July 1	Rake in just before flooding Clay balls, depth of 6-36".
	Tubers	Cold water storage Cold damp storage in straw or like substance.	Same	Pressing into bottom mud, Clay balls, depth of 6 - 36".
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud, or by using clay balls.
Redhead grass (P. obtusifolius)	Same as above	Same as above	Same as above	Same as above
Leafy Pondweed (P. foliosus)	Seeds	Cold water storage in winter.	Spring break-up to July 1	Rake in just before flooding Clay balls at depth of 6-36"
	Root-stocks	Cold water storage or damp storage in * straw or like substance.	Same as above.	Press in bottom mud Clay balls at depth of 6-36"
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clumps of 4-6 leafy stems pressed in bottom mud or Clay balls depth 6-36".
Wigeon Grass (Ruppia maritima)	Seeds *	Cold water storage Damp storage in straw or like substance.	Spring break-up to July 1	Soak seed until it sinks, then broadcast, depth 6-36".
	Root-stocks *	Same as above	same as above	Press in bottom mud, or Clay balls, depth 6-36".
	Leafy stems	Water storage 1-3 days, better to plant immediately.	June 15 to Aug. 1	Clump of 4-6 leafy stems pressed in bottom mud or by using clay balls depth 6-36".
Duck potato (Sagittaria latifolia)	Seeds (Not dependable)	Cold water storage in winter.	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
	Tubers	Cold water storage during winter, cold damp storage in straw or like substance.	Spring break-up to June.	Clay balls or pressed in bottom mud, water level to 10" depth.
Wild Millet (Echinochloa crus-gallii)	Seed	Dry storage	Spring break-up to July 1	Sow or drill.
Wild Rice (Zizania aquatica)	Seed	Keep moist and plant immediately. Cold storage during winter.	Sept. to period of freeze-up & Spring break-up to June 1	Sow in water, depth 6-36 ".
Cord grass (Spartina michauxiana)	Root-stocks	*Damp storage during winter, * Transplant directly.	Spring break-up to(*) Aug.	Press in or cover with thin layer of soil.
Needle rush (Eleocharis acicularis)	Whole plant	*Keep moist * Damp storage during winter.	Spring break-up to Sept. 1	Slightly above water level.
Hardstem bulrush (Scirpus acutus)	Root-stocks or whole plant.	Left in piles with dirt left on. Damp cold storage, cold water storage, during winter.	Spring break-up to Freeze-up	Press in bottom soil at water level to 5 feet below water level. Best results from spring to summer planting.
Prairie bulrush (S. pallidosus)	Tubor or whole plant	Piled outside and covered with dirt and straw. Damp cold storage, water storage during winter.	Spring break-up to freeze-up	Press in bottom soil at water level to 18" below water level.
Pale smartweed (Polygonum lapathifolium)	Seed	Dry storage (Grows best mixed with wild millet).	Spring break-up to June 15	Drill or sow and rake in at depth of slightly above water level to water level.
Swamp smartweed (P. muhlenbergii)	Seed	As yet have not heard of satisfactory results from seed planting.		
	Whole plant Stem or cuttings in lower part of stem at least 2 nodes.	Water storage several days	June 15 to Aug. 15	Anchor bottom so that there is 2-12" of water over top part of stem which must remain under water till it sprouts.
		Cold water storage during winter for stem cuttings.	Spring break-up to June 1	Same as above.

Des Lacs Refuge

Dams: Approval of dam projects for impounding water for nesting waterfowl and botulism control is pending.

Ditching: The propose ditching in pondsite #2 which was previously favorably commented on by Mr. Kubichek during his visit last fall and certainly deserves consideration, was disapproved as a C.C.C. project.

Tree and Shrub Planting: A tree and shrub planting program drawn up by Mr. Low as a result of a conference with Mr. Latson and myself was returned. This program will be altered to confoem with the proposals as outline by the Washington and regional office.

Copy of Narrative for Kubichek

The underlined in the report need attention.

NARRATIVE REPORT OF ACTIVITIES

January 1938

J. H. Steenis
Assistant Refuge Manager

INDEX

NARRATIVE REPORT OF ACTIVITIES

Fiscal Year 1938

L. H. Stennis
Assistant Refuge Manager

INDEX

Kubichek

NARRATIVE REPORT OF ACTIVITIES

Aleutian Island Report

An attempt to complete the narrative contribution to the Aleutian report dealing particularly with the description of plant types typical of the islands was dropped temporarly because of the piling up of other work on programs for the North Dakota refuges. I should be able to complete it during February.

North Dakota Refuges

During January, February and March programs covering spring and summer refuge development work is being drawn up.

Most of these projects will be drawn up by refuge managers, and if it seems necessary comments on the proposed work will be made by me.

Marsh and Aquatic Plants: Projects dealing with marsh and aquatic planting methods will recieve special consideration. We are waiting to see what Nature will give us in the line of water supplies.

Farming Program: The Regional Office has taken care of the farming program.

Tree Planting: Tree planting programs should be completed within the next two or three weeks.

Birds Fauna and Plant Surveys: We also hope to arrive at a definite plan for duck census work and plan for contributing to bird fauna, and plant surveys. These surveys will be secondary in importance, because the immediate work of administering and developing refuges will take up most of the time of the refuge managers. However, excellent progress has been made in this work on several refuges.

Certain phases of the work at Des Lacs, Lostwood and Upper Souris refuges deserve special consideration.

Des Lacs Refuge

The following is a report on Botulism and possible means of control. This problem certainly deserves immediate consideration.

Botulism Report

BOTULISM ON THE DES LACS REFUGE
AND CONTROL MEASURES

Outbreaks of Western Duck Sickness

Early Outbreaks of Western Duck Sickness: The Botulistic malady called Western Duck Sickness has been a problem on the Upper Des Lacs Lake for a number of years. Previous to the establishment of the Des Lacs Waterfowl Refuge by the Bureau of Biological Survey, sportsmen and conservationalists of Kenmare had recognized that a serious malady was killing ducks and their control measures of driving the birds out of the region of infection have saved thousands of birds. Fortunately, these attacks usually occur late in the summer and lowered temperatures unfavorable to Botulistic condition stops further sickness.

Western Duck Sickness Outbreak, 1935: In the early part of August, 1935, Mr. W. F. Kubichek observed surprisingly large amounts of Daphnia upon which thousands of ducks appeared to be feeding. Kubichek's prophecy that in 2 weeks time an attack of botulism would follow proved to be true and drives were started immediately to keep the birds out of the infected area. Cooler weather prevented further damage from this duck sickness. About a thousand birds died.

Western Duck Sickness Outbreak 1936: In 1936 the prolonged heat waves with their hot scorching winds resulted in a drop in water level, and caused an ideal condition for growth and propagation of large quantities of plankton, Daphnia, and aquatic insects which upon their death in turn appeared to have furnished an ideal media for the bacteria Clostridium botulinum type C. The toxin secreted by this bacteria was sufficiently concentrated so that another epidemic of duck sickness broke out on the extremely early date of July 9, 1937. Doctor E. R. Kalmbach told the writer that this is the earliest date that an outbreak of Botulism has been known to occur in this region. At the time of the outbreak there were 3246 ducks on the Upper Des Lacs Lake of which approximately 513 were young and unable to fly. Since the young readily succumbed to this disease without traveling far from the affected region it was an easy matter to figure out where botulism conditions were severe and where it was apparently lacking. Drives made daily to keep the birds out of the affected area met with only partial success. Dead birds were buried. ^ 13,700 dead birds were counted. Close to a thousand birds were successfully treated, banded, and placed in healthy waters. If these daily drives had not been made to keep the birds out of the infected water it is quite probable that 25,000 to 30,000 birds would have perished. During August, ducks, particularly pintails came in large numbers. It seems that the Upper Des Lacs is an area of concentration for pintails because of the mid-summer molt. Birds continued to suffer from western duck sickness till the second week in September.

Western Duck Sickness in 1937: The writer was not in this country during the summer of 1937, but from the information received from Mr. S. H. Low, Junior Refuge Manager, it appears that botulism was not much of a problem because a large portion of the Upper Des Lacs Lake dried up, particularly that part where Botulism had occured. However, a number of birds did succumb to this disease.

CAUSATIVE ORGANISM

The causative organism is the bacteria, Clostidium botulinum type C. It is not the bacteria itself that is directly responsible for this duck sickness but rather it is the toxin secreted by the bacteria that has proven to be so virulent to waterfowl.

Doctors E. R. Kalmbach and M. F. Gundersons technical bulletin number 411, 1934, entitled Western Duck Sickness, a Form of Botulism, explains that under ideal conditions rapid toxin production occurs between 82.4°F. to 98°F. Other points of particular interest that are brought out in this monograph is that this bacillus type of bacteria is anaerobic saprophytic, form spores resistant to adverse conditions which may persist for years, and prefers alkaline conditions.

"Preformed toxin may be effected adversely in nature by such factors as extreme alklinity or salinity, light, dessication or air." (page six) Another particular characteristic of the botulinum toxin that is worthy of note is its soluability and consequently its ability to become diluted in water. Also it is the concentration of toxin that is harmful to waterfowl; if the toxin becomes sufficiently diluted, it is not fatal to waterfowl.

CONTROL MEASURES

On the basis of the characteristics of this sickness outlined above possible control measures will be discussed. In the Summary of the paper Western Duck Sickness a Form of Botulism, the following statements explain what to consider in the order of control measures; (Page 77)

> "More lasting and effective means of prevention, however, lie in modifying or eliminating conditions that favor the development of the organism and the evolvement of its toxin. By flooding mud flats and shallow, stagnant water areas with deep or flowing water, temperatures are reduced and, through a process of dilution preformed toxin may be attenuated to the point of harmlessness. The expediency of temporarily cutting off all water from infected areas also has been used effectively where the ground may be completly dessicated and thus become unattractive to birds in midsummer."

Environment Conditions: Before discussing control measures it will be necessary to have a picture of conditions. The Upper Des Lacs Lake is a body of water about 25 miles long and 600 yards wide and 2 to 0 feet deep. During the spring of the year it is considerably deeper, but excessive evaporation due to this hot dry climate and the ever persistent winds causes water to recede till only relic lakes and ponds exist on the long meandering ribbon of the lake bottom. During the ice age, glacial drift effectively blocked the streamflow from the north just above the Canadian border, and thus prevented what is known as the Souris River from continuing its flow down this valley. Just north of Kenmare there is a rise in the valley floor that cuts offf the drainage of the Upper Des Lacs Lake from the south. The western shoreline is of a pulpy muck while the eastern, is mostly sand and gravel, and the lake bottom proper is for the most part mucky. The nature of this muck warrants its further consideration. Though it is physically broken down it is not chemically broken down into simpler components; and it consequently forms an ideal media for small water life such as Daphnia. The main supply of water comes off of some 15 coulees and several draws which have cut their way down along the steep hills of this valley. Only one small seepage spring was found along this lake. During midsummer the water becomes more brackish and is badly roiled and clouded with plankton, Daphnia, nymphs of numerous insects, and like. The decay of this small water life appears to form an excellent media for the causative organisms for western duck sickness.

Duck Drives: The effectiveness of duck drives has already been discussed. However, there are a few points of particular significance about these drives. When the temperature dropped below 80° F., there was a distinct let up in the duck sickness. In 1935 the outbreak of botulism was broken, while in 1936 the duck mortality dropped considerably, but naturally, came back with the rise of temperatures. The effect of a severe hot day on duck mortality was distinctly noticeable after 48 hours.

These observations tended to further verify conclusions in the paper of Kalmbach and Gunderson.

Chemical Treatment: With reference to chemical treatment Kalmbach and Gunderson state:

> "Treatment of infected areas with antiseptics or other substances, with the object of destroying the causative organism, preventing toxin production, or neutralizing toxin already formed, is a matter to which some consideration has been given though no field experimental work on it has been done. The immensity of the infected areas and the difficulty of reaching submerged spots of toxin, as well as the deleterious effect of powerful antiseptics on vegetation and possibly even on wildfowl, are obstacles that at this time make such treatment impracticable.

Whether a chemical treatment of infected areas so as to change them from a condition of alkalinity to one of neutrality or even acidity with respect to the hydrogen-ion concentration, would improve matters is yet to be determined. It is a fact that the range of duck sickness as it occurs in epizootic form coincides, to a marked degree, with that of the alkaline waters of this country. It is true also that the toxin of botulism is elaborated to a greater degree or in more potent form in alkaline media. The prospect of attacking the duck-sickness problem, however, through altering on an extensive scale the hydrogen-ion concentration in waters frequented by the birds does not appear promising, though the procedure may be worth trial in localized spots of infection."

Doctor E. O. Jordan classifies bacteria into 3 groups with reference to behavior to oxygen: obligate aerobes, ~~obligate anaerobes~~ obligate anaerobes, and facultative anaerobes of which Clostedium botulinum belongs to the obligate anaerobes. Jordon states (in his book, General Bacteriology, tenth edition, page 84, and 85) "The peculiar phenomenon of anaerobiosis may perhaps be explained by supposing that anaerobes are bacteria specially qualified to obtain their needed energy from the simple splitting of organic compounds without oxidation". With reference to this quotation and to the character of this bacteria not being able to thrive in the presence of free oxygen, would not the presence of a strong oxidising agent such as potassium permanganate ($KMnO_4$) cause adverse conditions.

During the summer of 1937, Mr. Roy Bach, biologist for easement refuges in North Dakota is reported to have had some success in using $KMnO_4$ solution in treating botulistic infected areas.

Control measures of this nature would be difficult to apply because of the impossibility of getting next to the water film of flats and extreme shallow water areas without getting mired. This condition is a striking and disagreeable feature of the Upper Des Lacs Lake. This obstacle could in part be corrected by using a mud queen of the type used on Bear Lake, Utah.

It is quite obvious, as explained above, that such control measures could not be applied. However, in smaller and more accesible areas this chemical means of control might be very valuable.

Botulism Control by Causing Oxidation by Mechanical Means: Bach is also reported to have had success with controlling the disease by scratching or disturbing areas known to be affected by this bacteria so that direct contact with the air and light will destroy the virulent toxinard cause the bacteria itself to die or form spores which are resistant to adverse conditions.

Such methods as previous stated would be difficult to apply due to the inaccessibility and size of the infected area.

Creating of a Biological Balanced Condition: Field observation have shown that shallow bodies of water surrounded by marsh plants growing into the water and populated with beds of aquatic plants creates an environment that is not indusive to botulism. (Lower Des Lacs Lake an example) Possibly the oxygen liberated in the water by the photosynthesis of aquatic plants might be of significance.

During the latter part of May to the early part of July 1936 a pronounced green bloom, apparently phyto-plankton, whose photosynthetic action produces more oxygen than a bed of macroscopic plants was dominant in these waters. (Reference is made to professors E. A. Birge and C. Juday studies on plankton and dissolved gasses as presented in The Inland Lakes of Wisconsin, The Plankton, Its Quantity and Chemical Composition, and The Dissolved Gasses of the Water and Their Biological Significance, Wisconsin Geological and Natural History Survey, bulletin number 64, scientific series number 13, and bulletin number 22, scientific series no. 7.) (and also to the writers field work while with the Wisconsin Land Inventory.)

It is of particular signifance to note that when this green bloom of phyto plankton gave way to a roiled brown water condition, botulism set in. Further more in the northern part of the Upper Des Lacs Lake where there was no botulism attack, the green plankton bloom remained dominant. CCC employed on the daily duck drives also noticed this change. This phenomenom tends to show that the presence of aquatic chlorophyl bearing plants in sufficient quantities may be used as an effective means of controlling botulism. However, experimental plot studies in 1936 showed that efforts to introduce marsh and aquatic plant in the Upper Des Lacs Lake would be unsuccessful.

Draining of the Infected Area: Draining of the infected area would be a sure means of control, but unfortunately natural conditions, the pulpy nature of the muck bottom, makes the use of machinery to dig a channal for draining numerous small bodies of water impossible.

Introducing of Fresh Water for Flushing and Raising the Water Level: If part of the Upper Souris River could be made to enter the Upper Des Lacs by digging a channel through the glacial drift, Botulism could be controlled. This is impossible since the work would have to be done in Canada, although the Des Lacs and Souris valleys are quite close together a short ways above the border. Furthermore much diversion of water would be harmful to the Upper and Lower Souris Refuges.

Deepening of the Present Water Channel: Deepening of the present water channel as explained in Kalmbach's and Gunderson's bulletin would appear to be one of the most effective means of controlling this duck sickness. During a field trip with Kalmbach on the Des Lacs Refuge in 1936, he said that if only this body of water was a least 2 feet deep we would not be bothered with duck sickness.

On July 23, 1937, (the writer was out of the States at the time) Kalmbach and agricultural engineers checked over the area with reference to starting a program that would prevent further outbreaks of botulism. It was decided that ditching the area so the water line would be well defined thus doing away with water filmed mud flats and extreme shallow water conditions and also causing a greater depth of water, would solve the problem. Kalmbach pointed out that a greater depth of water would not be so affected by extreme high temperatures and also be conducive to the dilution of this soluable toxin.

A ditching project was drawn up, approved, and started. It is indeed to be regretted that satisfactory progress has not been made. The ditch as previously planned was started along the east side of the lake where the beach appears to be for the most part sandy and gravelly, but unfortunatly this sand and gravel was often mixed with muck or over laid on top of muck to such an extent that a necessary base for using a dragline could not be found. Another dissappointing factor was that the pulpy muck tended to slough back and destroy the effectiveness of the ditching.

Impounding of water in Coulee Dams for Botulism Control: In discussing the foregoing control measures, an attempt has been made to show that while each may be effective under certain conditions, none fit the particular conditions existing on the Upper Des Lacs Lake.

Now let us consider the impounding of water in coulee dams for botulism control in Upper Des Lacs Lake.

It is a known fact that a good rain will break up a serious attack of Botulism. Resulting low temperatures, dilution of the soluble toxin, and other factors aid in preventing a poisonous Botulistic condition. In view of this fact, why not imitate or rather guide Nature by impounding large quantities of water and dispersing it into the affected area when an attack of botulism occurs. Since botulism usually occurs fairly late in the summer and is shortly followed by cooler temperature in this northwest prairie country, duck sickness outbreaks can in this way be controlled until cooler weather brings lower temperatures.

Constructive Projects of Biological Importance for the Des Lacs and Lostwood Refuges

Since considerable time has been spent on working up proposed constructive projects on biological development for the Des Lacs and Lostwood refuges it is being included in this narrative report of activities.

These proposed projects are being sent by way of the Regional Office to the Washington Office as previously instructed.

Construction Projects for Biological Development on the Des Lacs Waterfowl Refuge

Coulee dam projects have been discussed and proposed on the Des Lacs Refuge ever since 1935. It was given further impetus by Mr. Salyer in his conference with biological personel on North Dakota refuges on November 5, 1936. Mr. Kubichek is agreeable too and has recommended coulee dam construction during his field trips in this area. In the August narrative report for 1936 the importance of impounding water in coulees as a means of controlling western duck sickness, Botulism was explained and later discussed and favorably commented on at a Biological Survey staff meeting in Washington, D. C. by the Writer. During the summer of 1937, the impounding of water in coulees was again brought up by Mr. Low, Junior Refuge Manager. From an engineering and construction standpoint, Mr. Lansing, engineer and camp superintendent has pointed out the feasability of such projects. So far no constructive progress has been made in this kind of work.

Further explanation and necessities for coulee dams from a biological standpoint will be discussed under the following headings: (1) Impounding of water in coulee dams for Botulism control, and (2) Impounding of water in coulee dams primarily for nesting waterfowl.

Coulee Dams for
Botulism Control

Coulee Dams for Botulism Control

Location: Of the several desirable coulees on the Upper Des Lacs Lake, the larger coulees in the region of heavy botulistic infection at the following locations (see map) have been chosen for the construction of large coulee dams, needed for impounding water for botulism control:

T. 162 N., R. 88W., S 15, 22
T. 162N., R. 88W., S. 31
T. 161 N., R. 88W., S. 5, 8
T. 161 N., R. 88W., S. 21

Nature of Project: Since these coulees drain an unusually large watershed, it will be possible to impound a large body of water. Though small dams have been built in 2 of these coulees, outside the refuge, field observations show that the holding back of these small bodies of water had very little effect during the spring run off.

It will be necessary to have high dams with spillway and control gates so that considerable amounts of water can be let out when necessary. Contour maps have already been made of these coulees by the technical personel of theCCC and a plan for the construction of one of these dams in what is known as the Swenson Coulee, T. 161 N., R. 88 W., S. 5 & 8. Blue prints of this plan for dam construction was submitted to the regional office and received favorable comment.

With reference to the construction of these dams, Lansing pointed out that considerable time can be saved by constructing these four dams at the same time. Mr. Lansing estimates that under favorable conditions with the machinery that is available the constructions of these dams could be completed in one years time. This project will involve the use of dirt moving machinery, skilled CCC personel, and a relatively small percentage of CCC labor.

Further explanation is necessary on the proposed plan of impounding water in what is known as the Nelson Coulee, T. 162 N., R. 88 W., S. 15 & 22, because part of the water impounded by the dam would be outside the refuge. However, an easement can easily be procured from the owner for impounding of water on this small portion of his land since it will furnish a desirable watering place for his cattle.

Biological Importance: Reference is made to the report Botulism on the Des Lacs Refuge and Control Measures . After an effort had been made to apply various means of control, it appears that the use of coulee dams for botulism control would be the most effective.

It is a known fact that a good rain will break up a serious attack of botulism. Resulting low temperatures, dilution of the soluble toxin, and other factors aid in prevent-

dig a poisonous botulistic condition. In view of this fact, why not imitate or rather guide Nature by impounding large quantities of water and dispersing it into the affected area when an attack of botulism occurs. Since botulism usually occurs fairly late in the summer and is shortly followed by cooler temperatures in this northwest prairie country, duck sickness outbreaks can in this way be controlled until cooler weather brings lower temperatures.

A second and very worthwhile point to consider about the impounding of large bodies of water is that under extreme drough conditions when a large part of the lake dries up there will undoubtedly always be water behind these dams providing the gates are kept shut. Consequently at least part of the valley will have open bodiesof water in them for nesting ducks as well as other waterfowl.

Impounding of water Behind Small
Coulee Dams for Nesting Waterfowl.

Location: Reference is made to the map sent with this report. Desirable areas for small dam sites are numbered 5 to 10, of which dam sites 9, 10, 5, 7, 6, 8, appear to be the most desirable in the order named and consequently should be built first.

Nature of Projects: Contour maps have already been made of the more desirable coulees suitable for dams on the Upper Des Lacs Lake. Water impounded will be about 1 to 10 acres. For the most part, the proposed impounded water areas are sufficiently back in the coulees so that they will be protected from direct action of the wind. Consequently they will not be exposed to excessive evaporation. Though spillways will be necessary, it will not be necessary to build in control gates. For more details consult map and CCC Camp BF-3.

Biological Importance: It is a known and much observed fact that ducks prefer nesting sites adjoining small ponds to the larger bodies of water. Low has further amplified the significance of small bodies of water for nesting birds and shown actual proof by pictures in his narrative report for July, 1937, and annual report for 1937.

Ditching Project and Small
Island Construction in Pondsite #2.

Location: Pondsite #2 immediately above the sub-headquarters is the location for the proposed ditching project and island construction.

Regional office favorable to this

Needs further consideration
Turned down by Regional
Office

Nature of Project: This project was proposed and sent to the regional office on May, 1937, by Mr. Low. The plan for ditching was shown on a contour map. These ditches should be about 20 feet wide. Soil from the ditch excavations, rather than being left in piles, should be used, in part, for building small nesting islands for waterfowl in the original open water areas in pondsite #2.

Islands should be built not more than one foot above water level. Width and length above water level should be three to four feet. These islands should be 100 feet apart. Erosion of these islands can be controlled by planting rootstock of hardstem bulrush around them, which will in turn grow a protective rip rap of rootstocks around the island. The tops of these know islands can be planted with cordgrass and other marsh plants.

Biological importance: The biological importance of this ditching project is demonstrated by the condition that already exists in the northern part of this pondsite #2. Natural drainage channels and ditches along old roads and railroad beds have proved to be an ideal environment for waterfowl in spite of the water being below spillway level.

Another important point to consider is that this pondsite has water in it the year around in spite of adverse conditions.

Nest studies made in 1936 have shown that this area was one of the concentration points for breeding birds.

These studies have also shown that predators, particularly the skunk, have destroyed many of the nests in this region. This ditching project surrounding desirable nesting areas would protect the area from further predator activities providing it was properly trapped. Predators such as skunk, coyote, cats etc., would not swim to islands unless hard pressed by some outside factor.

From the standpoint of fire control alone this ditching project is desirable for the protection of wildlife.

CONSTRUCTION PROJECTS FOR
BIOLOGICAL DEVELOPMENT LOSTWOOD
WATERFOWL REFUGE

From time to time during the past month an effort has been made by Mr. Seth Low, Junior Refuge Manager, and others to start projects on the impounding and diversion of water, and building of islands. The biological significance of this work warrants further consideration and shows that the following projects should be included in the next CCC work period.

Coulee Dam Diversion
For Elbow Lake

Location: Close to what was once known as Elbow Lake, one of the largest coulees in the vicinity runs out of the refuge. (See narrative report for Lostwood Refuge, May, 1937)

Nature of Project: Two dams were proposed in Sec. 14, T. 159 N., R. 92 W. which would impound small ponds of water and cause other water to run into Elbow Lake which is at the present time dry.

A blue print copy of the drawing of dam construction for this project and details on construction of the dams have been sent to the Regional Office. In the Narrative report on Lostwood Refuge for May, 1937 are pictures showing run off of water in this coulee. With reference to these pictures one must remember that last winter's snow was light and that run off conditions were very poor.

Biological Importance: The biological significance of this proposed work which received favorable comments from Mr. Salyer, is immediate because it will impound a small pond of water desirable for nesting waterfowl, but is more important in that a large amount of water that would normally run off the refuge is held with in the refuge and diverted into the present dry bed of Elbow Lake. The value of diverting the water into this lake bed is remote because run off from this coulee will probably not be sufficient to fill the lake during this drought period, but it will greatly hasten the availability of this lake for waterfowl when there is more moisture in this region. The gentle sloping shoreline of this medium sized long crooked lake, bordered with remnants of desirable vegetation and surrounded by hills where there are clumps of the dwarfed buckbrush, (Symphoricarpus racemosus) indicate that an ideal environment will result for breeding ducks with the return of water.

Repair of Dam in the Knudson Tract.

Location: On the Knudson tract T. 159 N., R. 91 W., Sec. 21, is one of the best duck areas on the refuge.

Nature of Project: A small dam impounding the water run off from seepage springs has caused an ideal marsh condition dominated by hardstem bullrush (Scirpus acutus). IN the open water and among the rushes are the aquatics, sago pondweed (Potamogeton pectinatus) muskgrass (Chara sp.) and bladderwort (Utricularia vulgaris). Since there is a seepage of water around this dam, a clay fill is necessary to prevent further seepage. While this work is being done it might be advantageous to raise the dam 1 to 1½ feet so that if the springs become more active larger marsh and open water area will result.

Biological Importance: The value of this work for waterfowl is portrayed in the nature of the work. If the water level is raised much over 1½ feet, the existance of the present marsh growth would be endangered.

Island Construction

Location: Water recession due to drought has shown natural conditions which could advantageously be altered and made into permanent islands on the 3 large brackish lakes, Thompson, Upper Lostwood and Lower Lostwood Lakes in the Northern, Central, and Southern part of the refuge.

Nature of Project: Water recession in Upper Lostwood and Thompson Lakes has revealed 6 low water islands of boulders, gravel and sand which (as previously state by Low) could be improved by building up to the height of normal waterlevel (about 2 to 3 feet). The rugged nature of boulders and gravel which would be used in the construction of the outer portion of the island would insure its permanent location in spight of wave action. It would seem advisable to concentrate on the outer portion in building up these islands.

During a recent fiedd trip and conferende with our engineer and camp superintendent, Mr. L. Lansing, and Mr. Low, Lansing explained that it was perfectly feasable from an engineering and construction standpoint to build these islands. The firm lake bottom and shallow water between the main land and the island can not be considered much of a barrier in doing this work since it would be an easy matter to build an earth fill road to the island and deposit a large amount of this earth road upon the island as the earth moving equipment is taken off.

Of the six suitable sites for this kind of island development, four of the more desirable have been chosen. In Thompson Lake chosen sites are located on the north and south end, and in Upper Lostwood Lake chosen sites are the two larger islands seen on the west side.

Conditions at the Lower Lostwood Lake are different. With reference to this lake Low adequately states, "Lower Lostwood Lake has not revealed any low-water 'islands'. By ditching, however, there is a possibility of creating a very large island at the north end of the slough. This has been indicated by the accompanying map." (Map was sent to the Regional Office by Low with letter of explanation dated December 11, 1937) "The map is far from accurate. It shows the three sloughs as being widely separated. Such is not the case. Each is separated from the other by a narrow sandy isthmus."

Biological Importance: When the water approaches normal levels again there will be no islands if this construction work is forsaken. Since the importance of islands for waterfowl is well known, nothing more need be added on this subject.

The nature of the construction of these islands will make them desirable for a greater variety of birds than islands that are built on other refuges. The brackish nature of the coarse stoney lake bottom material that will be used along the outer edges of the islands will tend to discourage plant growth and thus will result in desirable nesting sites particularly for some of the shore birds, such as avocets which do not choose vegetative cover sites for nesting. On the more central part of the islands where a soil fill suitable for plant life can be placed, there will be a suitable environment for waterfowl desiring plant cover.

Perhaps a still more favorable impression of this proposed island construction can be shown by following a biological trend of change from the present to a possible future condition. At present these islands appear to be built in brakish water that might be classed as an aquatic desert. But this is far from being true. To be sure there is no fish or macroscopic plant life, but the abundance of aquatic insect life, particularly Corixas spp. is surprising. A swim in Thompson Lake was made rather unpleasant by Corixas which had a tendency to bite causing a feeling of being pin pricked. During the fall the very great amount of exoskeletons of aquatic insects washed up on the east shore of Lower Lostwood Lake was surprising. These water insects serve as food particularly for shorebirds, also for ducks, as well as other waterfowl. In the future when the alkali condition of these waters is diluted, aquatic plant and fish life that are tolerant to less brakish conditions can be introduced and these large water tracts will become better suited to ducks and other fowl such as grebes, cormorants, pelicans, and terns, which prefer and in some cases require islands for nesting places.

Conclusion

Although from an engineering or constructive standpoint these proposed jobs may not seem to be very impressive, from a biological standpoint the results of this work will compare very favorable with work of the same type done on other refuges.

Another point of particular interest bearing on this work is that the improvement work asked for contributes to the environmental desirability of the refuge during a drought period and more so during a time of rainfall.

Upper Souris Refuge

Fish Stockings A proposed and future project worthy of consideration on the Upper Souris Refuge is the stocking of Lake Darling and lower pondsites with fish. The pondsite above dam # 41 should not be stocked until it is filled with water.

Oxygen Supply: It appears that there is sufficient depth in these bodies of water to insure a sufficient oxygen content over and above that necessary for decay and respiratory processes of aquatic life so that fish will not die from lack of oxygen during the winter freeze over. (These conclusions are based on lake studies made by the writer with the Wisconsin Land Inventory 1930-1935 and on the more intensive and precise studies of professors E. A. Birge, C. Juday and associates of the Limnological Laboratory of the Wisconsin Geological and Natural History Survey.)

Food Supply: Field observations of 1935, 1936 and 1937, by the personel employed on this refuge and by the writer certainly shows that there is an ample supply of forage fish, or minnows necessary as food for game fish. Fresh water shrimp and particularly large numbers of aquatic insects have also been observed in these waters. Of the marsh and aquatic plants that have a direct and indirect bearing on fish life, beds of leafy pondweed (Potamogeton foliosus) and swamp smartweed (Polygonum muhlenbergii) are worthy of special note. Other pondweeds in this area are sago pondweed (Potamogeton pectinatus) and redhead grass (P. richardsonii)

Observation on Age and Fish Growth: It is to be regretted that very little work has been done on field studies dealing with the growth of fish in reference to there age. Attempts will be made to do some of this work in the immediate future.

Recently a 16 pound northern pike (Esox lucius) was caught by locals just north of the refuge. Scale studies show that this fish to be 7 years old. Upon further checking on old notes it appears that this is an exellent growth for this fish and tends to indicate that food conditions for game fish are very good. It is also interesting to note that this fish must have devoured 260 to 270 pounds of food, mainly minnows, in order to reach the weight of 16 pounds. An application of the above information on fish environment implies the planting of fish in these waters. Such a program as previously shown and explained by superior officials fits in to the proposed purposes of a refuge sine it will tend to produce an out flow of wildlife that is of direct value to sportsmen and conservationists.

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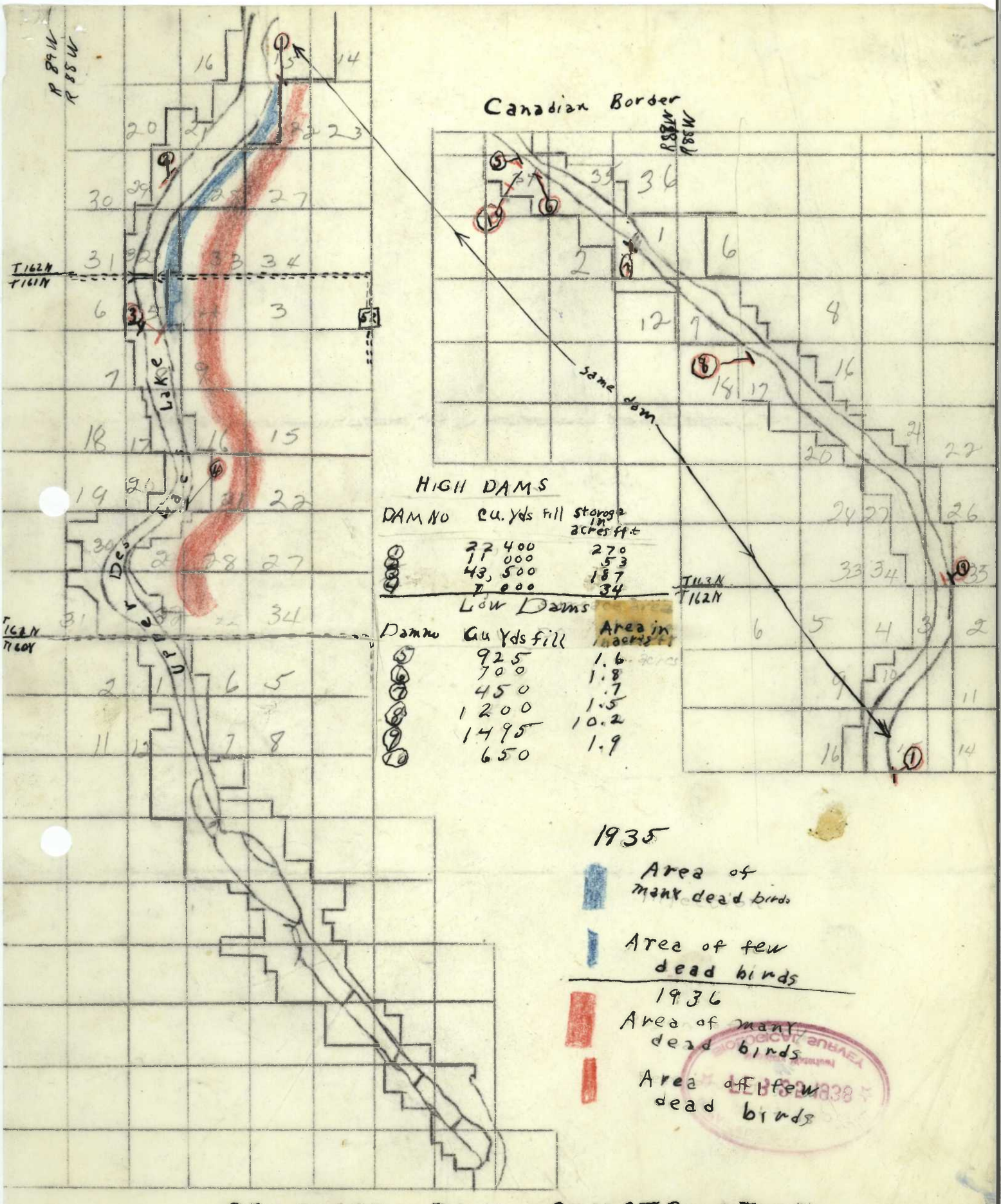


HIGH DAMS

DAM NO	Cu. Yds fill	Storage in acres ft.
1	22 400	270
2	11 000	53
3	43, 500	187
4	1 000	34

Low Dams

Dam no	Cu Yds fill	Area in acres ft
5	925	1.6
6	700	1.8
7	450	.7
8	1 200	1.5
9	1495	10.2
10	650	1.9

1935

Area of many dead birds

Area of few dead birds

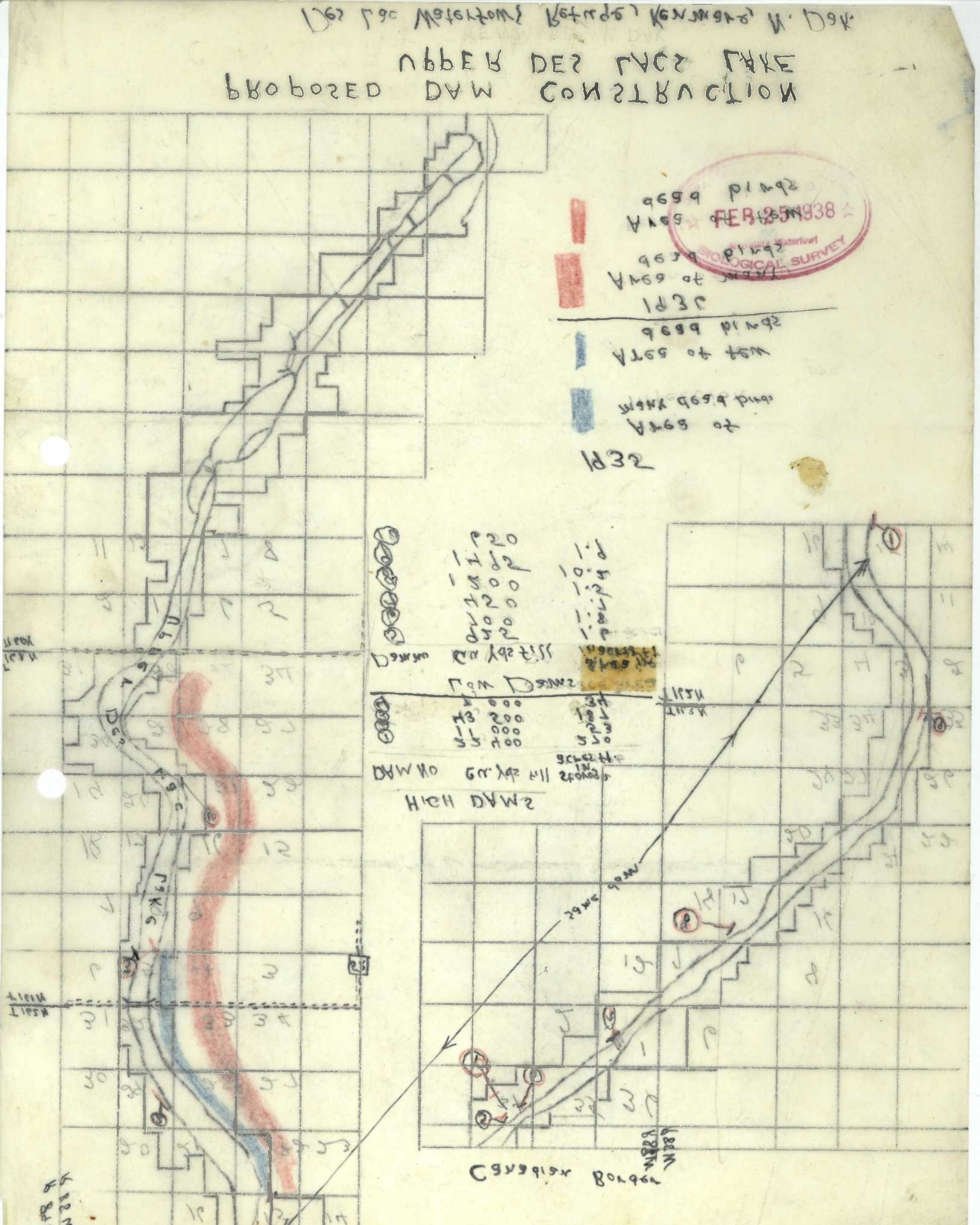
1936

Area of many dead birds

Area of few dead birds

PROPOSED DAM CONSTRUCTION UPPER DES LACS LAKE

Des Lac Waterfowl Refuge, Kenmare, N. Dak.



NARRATIVE REPORT OF ACTIVITIES
January 1938

Duplicate copy.

Aleutian Island Report

An attempt to complete the narrative contribution to the Aleutian report dealing particularly with the description of plant types typical of the islands was dropped temporarly because of the piling up of other work on programs for the North Dakota refuges. I should be able to complete it during February.

North Dakota Refuges

During January, February and March programs covering spring and summer refuge development work is being drawn up.

Most of these projects will be drawn up by refuge managers, and if it seems necessary comments on the proposed work will be made by me.

Marsh and Aquatic Plants: Projects dealing with marsh and aquatic planting methods will recieve special consideration. We are waiting to see what Nature will give us in the line of water supplies.

Farming Program: The Regional Office has taken care of the farming program.

Tree Planting: Tree planting programs should be completed within the next two or three weeks.

Birds, Fauna and Plant Surveys: We also hope to arrive at a definite plan for duck census work and plan for contributing to bird fauna, and plant surveys. These surveys will be secondary in importance, because the immediate work of administering and developing refuges will take up most of the time of the refuge managers. However, excellent progress has been made in this work on several refuges.

Certain phases of the work at Des Lacs, Lostwood and Upper Souris refuge deserve special consideration.

WCL 3-3-38

Des Lacs Refuge

The following is a report on Botulism and possible means of control. This problem certainly deserves immediate consideration.

Botulism Report

BOTULISM ON THE DES LACS REFUGE
AND CONTROL MEASURES

Outbreaks of Western Duck Sickness

Early Outbreaks of Western Duck Sickness: The Botulistic malady called Western Duck Sickness has been a problem on the Upper Des Lacs Lake for a number of years. Previous to the establishment of the Des Lacs Waterfowl Refuge by the Bureau of Biological Survey, sportsmen and conservationalists of Kenmare had recognized that a serious malady was killing ducks and their control measures of driving the birds out of the region of infection have saved thousands of birds. Fortunately, these attacks usually occur late in the summer and lowered temperatures unfavorable to Botulistic condition stops further sickness.

Western Duck Sickness Outbreak. 1935: In the early part of August, 1935, Mr. W. F. Kubichek observed surprisingly large amounts of Daphnia upon which thousands of ducks appeared to be feeding. Kubichek's prophecy that in 2 weeks time an attack of botulism would follow proved to be true and drives were started immediately to keep the birds out of the infected area. Cooler weather prevented further damage from this duck sickness. About a thousand birds died.

Western Duck Sickness Outbreak 1936: In 1936 the prolonged heat waves with their hot scorching winds resulted in a drop in water level, and caused an ideal condition for growth and propagation of large quantities of plankton, Daphnia, and aquatic insects which upon their death in turn appeared to have furnished an ideal media for the bacteria, Clostridium botulinum type C. The toxin secreted by this bacteria was sufficiently concentrated so that another epidemic of duck sickness broke out on the extremely early date of July 9, 1937. Doctor E. R. Kalmbach told the writer that this is the earliest date that an outbreak of Botulism has been known to occur in this region. At the time of the outbreak there were approximately 3246 ducks on the Upper Des Lacs Lake of which approximately 513 were young and unable to fly. Since the young readily succumbed to this disease without traveling far from the affected region it was an easy matter to figure out where botulism conditions were severe and where it was apparently lacking. Drives made daily to keep the birds out of the affected area met with only partial success. Dead birds were buried. After 7 weeks of epidemic approximately 13,700 dead birds were counted. Close to a thousand birds were successfully treated, banded, and placed in healthy waters. If these daily drives had not been made to keep the birds out of the infected water it is quite probable that 25,000 to 30,000 birds would have perished. During August, ducks, particularly pintails came in large numbers. It seems that the Upper Des Lacs is an area of concentration for pintails because of the mid-summer molt. Birds continued to suffer from western duck sickness till the second week in September.

Western Duck Sickness in 1937: The writer was not in this country during the summer of 1937, but from the information received from Mr. S. H. Low, Junior Refuge Manager, it appears that botulism was not much of a problem because a large portion of the Upper Des Lacs Lake dried up, particularly that part where Botulism had occured. However, a number of birds did succumb to this disease.

CAUSATIVE ORGANISM

The causative organism is the bacterial Clostidium botulinum type C. It is not the bacteria itself that is directly responsible for this duck sickness but rather it is the toxin secreted by the bacteria that has proven to be so virulent to waterfowl.

Doctors E. R. Kalmbach and M. F. Gundersons technical bulletin number 411, 1934, entitled Western Duck Sickness, a Form of Botulism, explains that under ideal conditions rapid toxin production occurs between 82.4°F to 98°F. Other points of particular interest that are brought out in this monograph is that this bacillus type of bacteria is anaerobic, saprophytic, form spores resistant to adverse conditions which may persist for years, and prefers alkaline conditions.

"Preformed toxin may be affected adversely in nature by such factors as extreme alklinity or salinity, light, dessication or air." (page six) Another particular characteristic of the botulinum toxin that is worthy of note is its soluability and consequently its ability to become diluted in water. Also it is the concentration of toxin that is harmful to waterfowl; if the toxin becomes sufficiently diluted, it is not fatal to waterfowl.

CONTROL MEASURES

On the basis of the characteristics of this sickness outlined above possible control measures will be discussed. In the Summary of the paper Western Duck Sickness a Form of Botulism, the following statements explain what to consider in the order of control measures: (Page 77)

> "More lasting and effective means of prevention, however, lie in modifying or eliminating conditions that favor the development of the organism and the evolvement of its toxin. By flooding mud flats and shallow, stagnant water areas with deep or flowing water, temperatures are reduced and, through a process of dilution preformed toxin may be attenuated to the point of harmlessness. The expediency of temporarily cutting off all water from infected areas also has been used effectively where the ground may be completly dessicated and thus become unattractive to birds in midsummer."

Environment Conditions: Before discussing control measures it will be necessary to have a picture of conditions. The Upper Des Lacs Lake is a body of water about 25 miles long and 600 yards wide and 2 to 0 feet deep. During the spring of the year it is considerably deeper, but excessive evaporation due to this hot dry climate and the ever persistent winds causes water to receed till only relic lakes and ponds exist on the long meandering ribbon of the lake bottom. During the ice age, glacial drift effectively blocked the streamflow from the north just above the Canadian border, and thus prevented what is known as the Souris River from continuing its flow down this valley. Just north of Kenmare there is a rise in the valley floor that cuts offf the drainage of the Upper Des Lacs Lake from the south. The western shoreline is of a pulpy muck while the eastern, is mostly sand and gravel, and the lake bottom proper is for the most part mucky. The nature of this muck warrants its further consideration. Though it is physically broken down it is not chemically broken down into simpler components; and it consequently forms an ideal media for small water life such as Daphnia. The main supply of water comes off of some 15 coulees and several draws which have cut their way down along the steep hills of this valley. Only one small seepage spring was found along this lake. During midsummer the water becomes more brackish and is badly roiled and clouded with plankton, Daphnia, nymphs of numerous insects, and like. The decay of this small water life appears to form an excellent media for the causative organisms for western duck sickness.

Duck Drives: The effectiveness of duck drives has already been discussed. However, there are a few points of particular significance about these drives. When the temperature dropped below 80° F., there was a distinct let up in the duck sickness. In 1935 the outbreak of botulism was broken, while in 1936 the duck mortality dropped considerably, but naturally, came back with the rise of temperatures. The effect of a severe hot day on duck mortality was distinctly noticeable after 48 hours.

These observations tended to further verify conclusions in the paper of Kalmbach and Gunderson.

Chemical Treatment: With reference to chemical treatment Kalmbach and Gunderson state:

> "Treatment of infected areas with antiseptics or other substances, with the object of destroying the causative organism, preventing toxin production, or neutralizing toxin already formed, is a matter to which some consideration has been given though no field experimental work on it has been done. The immensity of the infected areas and the difficulty of reaching submerged spots of toxin, as well as the deleterious effect of powerful antiseptics on vegetation and possibly even on wildfowl, are obstacles that at this time make such treatment impracticable.

Whether a chemical treatment of infected areas so as to change them from a condition of alkalinity to one of neutrality or even acidity with respect to the hydrogen-ion concentration, would improve matters is yet to be determined. It is a fact that the range of duck sickness as it occurs in epizootic form coincides, to a marked degree, with that of the alkaline waters of this country. It is true also that the toxin of botulism is elaborated to a greater degree or in more potent form in alkaline media. The prospect of attacking the duck-sickness problem, however, through altering on an extensive scale the hydrogen-ion concentration in waters frequented by the birds does not appear promising, though the prosedure may be worth trial in localized spots of infection."

Doctor E. O. Jordan classifies bacteria into 3 groups with reference to behavior to oxygen: obligate aerobes, ~~obligate anaerobes~~ obligate anaerobes, and facultative anaerobes of which Clostedium botulinum belongs to the obligate anaerobes. Jordon states (in his book, General Bacteriology, tenth edition, page 84, and 85) "The peculiar phenomenon of anaerobiosis may perhaps be explained by supposing that anaerobes are bacteria specially qualified to obtain their needed energy from the simple splitting of organic compounds without oxidation". With reference to this quotation and to the character of this bacteria not being able to thrive in the presence of free oxygen, would not the presence of a strong oxidizing agent such as potassium permanganate ($KMnO_4$) cause adverse conditions.

During the summer of 1937, Mr. Roy Bach, biologist for easement refuges in North Dakota is reported to have had some success in using $KMnO_4$ solution in treating botulistic infected areas.

Control measures of this nature would be difficult to apply because of the impossibility of getting next to the water film of flats and extreme shallow water areas without getting mired. This condition is a striking and disagreeable feature of the Upper Des Lacs Lake. This obstacle could in part be corrected by using a mud cueen of the type used on Bear Lake, Utah.

It is quite obvious, as explained above, that such control measures could not be applied. However, in smaller and more accesible areas this chemical means of control might be very valuable.

Botulism Control by Causing Oxidation by Mechanical Means: Bach is also reported to have had success with controlling the disease by scratching or disturbing areas known to be affected by this bacteria so that direct contact with the air and light will destroy the virulent toxinand cause the bacteria itself to die or form spores which are resistant to adverse conditions.

Such methods as previous stated would be difficult to apply due to the inaccessibility and size of the infected area.

Creating of a Biological Balanced Condition: Field observation have shown that shallow bodies of water surrounded by marsh plants growing into the water and populated with beds of aquatic plants creates an environment that is not indusive to botulism. (Lower Des Lacs Lake an example) Possibly the oxygen liberated in the water by the photosynthesis of aquatic plants might be of significance.

During the latter part of May to the early part of July 1936 a pronounced green bloom, apparently phyto-plankton, whose photosynthetic action produces more oxygen than a bed of macroscopic plants was dominant in these waters. (Reference is made to professors E. A. Birge and C. Juday studies on plankton and dissolved gasses as presented in The Inland Lakes of Wisconsin, The Plankton, Its Quantity and Chemical Composition, and The Dissolved Gasses of the Water and Their Biological Significance, Wisconsin Geological and Natural History Survey, bulletin number 64, scientific series number 13, and bulletin number 22, scientific series no. 7.) (and also to the writers field work while with the Wisconsin Land Inventory.)

It is of particular signifance to note that when this green bloom of phyto plankton gave way to a roiled brown water condition, botulism set in. Further more in the northern part of the Upper Des Lacs Lake where there was no botulism attack, the green plankton bloom remained dominant. CCC employed on the daily duck drives also noticed this change. This phenomenom tends to show that the presence of aquatic chlorophyl bearing plants in sufficient quantities may be used as an effective means of controlling botulism. However, experimental plot studies in 1936 showed that efforts to introduce marsh and aquatic plant in the Upper Des Lacs Lake would be unsuccessful.

Draining of the Infected Area: Draining of the infected area would be a sure means of control, but unfortunately natural conditions, the pulpy nature of the muck bottom, makes the use of machinery to dig a channal for draining numerous small bodies of water impossible.

Introducing of Fresh Water for Flushing and Raising the Water Level: If part of the Upper Souris River could be made to enter the Upper Des Lacs by digging a channel through the glacial drift, Botulism could be controlled. This is impossible since the work would have to be done in Canada, although the Des Lacs and Souris valleys are quite close together a short ways above the border. Furthermore much diversion of water would be harmful to the Upper and Lower Souris Refuges.

Deepening of the Present Water Channel: Deepening of the present water channel as explained in Kalmbach's and Gunderson's bulletin would appear to be one of the most effective means of controlling this duck sickness. During a field trip with Kalmbach on the Des Lacs Refuge in 1936, he said that if only this body of water was a least 2 feet deep we would not be bothered with duck sickness.

On July 23, 1937, (the writer was out of the States at the time) Kalmbach and agricultural engineers checked over the area with reference to starting a program that would prevent further outbreaks of botulism. It was decided that ditching the area so the water line would be well defined thus doing away with water filmed mud flats, and extreme shallow water conditions and also causing a greater depth of water, would solve the problem. Kalmbach pointed out that a greater depth of water would not be so affected by extreme high temperatures and also be condusive to the dilution of this soluable toxin.

A ditching project was drawn up, approved, and started. It is indeed to be regretted that satisfactory progress has not been made. The ditch as previously planned was started along the east side of the lake where the beach appears to be for the most part sandy and gravelly, but unfortunatly this sand and gravel was often mixed with muck or over laid on top of muck to such an extent that a necessary base for using a dragline could not be found. Another dissappointing factor was that the pulpy muck tended to slough back and destroy the effectiveness of the ditching.

Impounding of water in Coulee Dams for Botulism Control: In discussing the foregoing control measures, an attempt has been made to show that while each may be effective under certian conditions, none fit the particular conditions existing on the Upper Des Lacs Lake.

Now let us consider the impounding of water in coulee dams for botulism control in Upper Des Lacs Lake.

It is a known fact that a good rain will break up a serious attack of botulism. Resulting low temperatures, dilution of the soluble toxin, and other factors aid in preventing a poisonous botulistic condition. In view of this fact, why not imitate or rather guide Nature by impounding large quantities of water and dispersing it into the affected area when an attack of botulism occurs. Since botulism usually occurs fairly late in the summer and is shortly followed by cooler temperature in this northwest prairie country, duck sickness outbreaks can in this way be controlled until cooler weather brings lower temperatures.

Constructive Projects of Biological Importance for the Des Lacs and Lostwood Refuges

Since considerable time has been spent on working up proposed constructive projects on biological development for the Des Lacs and Lostwood refuges it is being included in this narrative report of activities.

These proposed projects are being sent by way of the Regional Office to the Washington Office as previously instructed.

Construction Projects for Biological Development on the Des Lacs Waterfowl Refuge

Coulee dam projects have been discussed and proposed on the Des Lacs Refuge ever since 1935. It was given further impetus by Mr. Salyer in his conference with biological personel on North Dakota refuges on November 5, 1936. Mr. Kubichek is agreeable too and has recommended coulee dam construction during his field trips in this area. In the August narrative report for 1936 the importance of impounding water in coulees as a means of controlling western duck sickness, Botulism, was explained and later discussed and favorably commented on at a Biological Survey staff meeting in Washington, D. C. ~~by the writer~~. During the summer of 1937, the impounding of water in coulees was again brought up by Mr. Low, Junior Refuge Manager. From an engineering and construction standpoint, Mr. Lansing, engineer and camp superintendent has pointed out the feasability of such projects. So far no constructive progress has been made in this kind of work.

Further explanation and necessities for coulee dams from a biological standpoint will be discussed under the following headings: (1) Impounding of water in coulee dams for Botulism control, and (2) Impounding of water in coulee dams primarily for nesting waterfowl.

Coulee Dams for
Botulism Control

Coulee Dams for
Botulism Control

Location: Of the several desirable coulees on the Upper Des Lacs Lake, the larger coulees in the region of heavy botulistic infection at the following locations (see map) have been chosen for the construction of large coulee dams, needed for impounding water for botulism control:

T. 162 N.,R. 88W., S 15, 22
T. 162N., R. 88W., S. 31
T. 161 N., R. 88W., S. 5, 8
T. 161 N., R. 88W., S. 21

Nature of Project: Since these coulees drain an unusually large watershed, it will be possible to impound a large body of water. Though small dams have been built in 2 of these coulees, outside the refuge, field observations show that the holding back of these small bodies of water had very little effect during the spring run off.

It will be necessary to have high dams with spillway and control gates so that considerable amounts of water can be let out when necessary. Contour maps have already been made of these coulees by the technical personel of theCCC and a plan for the construction of one of these dams in what is known as the Swanson Coulee, T. 161 N., R. 88 W., S. 5 & 8. Blue prints of this plan for dam construction was submitted to the regional office and received favorable comment.

With reference to the construction of these dams, Lansing pointed out that considerable time can be saved by constructing these four dams at the same time. Mr. Lansing estimates that under favorable conditions with the machinery that is available the constructions of these dams could be completed in one years time. This project will involve the use of dirt moving machinery, skilled CCC personel, and a relatively small percentage of CCC labor.

Further explanation is necessary on the proposed plan of impounding water in what is known as the Nelson Coulee, T. 162 N., R. 88 W., S. 15 & 22, because part of the water impounded by the dam would be outside the refuge. However, an easement can easily be procured from the owner for impounding of water on this small portion of his land since it will furnish a desirable watering place for his cattle.

Biological Importance: Referance is made to the report Botulism on the Des Lacs Refuge and Control Measures . After an effort had been made to apply various means of control, it appears that the use of coulee dams for botulism control would be the most effective.

It is a known fact that a good rain will break up a serious attack of botulism. Resulting low temperatures, dilution of the soluble toxin, and other factors aid in prevent-

ing a poisonous botulistic condition. In view of this fact, why not imitate or rather guide Nature by impounding large quantities of water and dispersing it into the affected area when an attack of botulism occurs. Since botulism usually occurs fairly late in the summer and is shortly followed by cooler temperatures in this northwest prairie country, duck sickness outbreaks can in this way be controlled until cooler weather brings lower temperatures.

A second and very worthwhile point to consider about the impounding of large bodies of water is that under extreme drough conditions when a large part of the lake dries up there will undoubtedly always be water behind these dams providing the gates are kept shut. Consequently at least part of the valley will have open bodiesof water in them for nesting ducks as well as other waterfowl.

Impounding of water Behind Small
Coulee Dams for Nesting Waterfowl.

Location: Reference is made to the map sent with this report. Desirable areas for small dam sites are numbered 5 to 10, of which dam sites 9, 10, 5, 7, 6, 8, appear to be the most desirable in the order named and consequently should be built first.

Nature of Projects: Contour maps have already been made of the more desirable coulees suitable for dams on the Upper Des Lacs Lake. Water impounded will be about 1 to 10 acres. For the most part, the proposed impounded water areas are sufficiently back in the coulees so that they will be protected from direct action of the wind. Consequently they will not be exposed to excessive evaporation. Though spillways will be necessary, it will not be necessary to build in control gates. For more details consult map and CCC Camp BF-3.

Biological Importance: It is a known and much observed fact that ducks prefer nesting sites adjoining small ponds to the larger bodies of water. Low has further amplified the significance of small bodies of water for nesting birds and shown actual proof by pictures in his narrative report for July, 1937, and annual report for 1937.

Ditching Project and Small
Island Construction in Pondsite #2.

Location: Pondsite #2 immediately above the sub-headquarters is the location for the proposed ditching project and island construction.

Nature of Project: This project was proposed and sent to the regional office on May, 1937, by Mr. Low. The plan for ditching was shown on a contour map. These ditches should be about 20 feet wide. Soil from the ditch excavations, rather than being left in piles, should be used, in part, for building small nesting islands for waterfowl in the original open water areas in pondsite #2.

Islands should be built not more than one foot above water level. Width and length above water level should be three to four feet. These islands should be at least 100 feet apart. Erosion of these islands can be controlled by planting rootstock of hardstem bulrush around them, which will in turn grow a protective rip rap of rootstocks around the island. The tops of these know islands can be planted with cordgrass and other marsh plants.

Biological importance: The biological importance of this ditching project is demonstrated by the condition that already exists in the northern part of this pondsite #2. Natural drainage channels and ditches along old roads and railroad beds have proved to be an ideal environment for waterfowl in spite of the water being below spillway level.

Another important point to consider is that this pondsite has water in it the year around in spite of adverse conditions.

Nest studies made in 1936 have shown that this area was one of the concentration points for breeding birds.

These studies have also shown that predators, particularly the skunk, have destroyed many of the nests in this region. This ditching project surrounding desirable nesting areas would protect the area from further predator activities providing it was properly trapped. Predators such as skunk, coyote, cats etc., would not swim to islands unless hard pressed by some outside factor.

From the standpoint of fire control alone this ditching project is desirable for the protection of wildlife.

CONSTRUCTION PROJECTS FOR
BIOLOGICAL DEVELOPMENT LOSTWOOD
WATERFOWL REFUGE

From time to time during the past month an effort has been made by Mr. Seth Low, Junior Refuge Manager, and others to start projects on the impounding and diversion of water, and building of islands. The biological significance of this work warrants further consideration and shows that the following projects should be included in the next CCC work period.

Coulee Dam Diversion
For Elbow Lake

Location: Close to what was once known as Elbow Lake, one of the largest couless in the vicinity runs out of the refuge. (See narrative report for Lostwood Refuge, May, 1937)

Nature of Project: Two dams were proposed in Sec. 14, T. 159 N., R. 92 W. which would impound small ponds of water and cause other water to run into Elbow Lake which is at the present time dry.

A blue print copy of the drawing of dam construction for this project and details on construction of the dams have been sent to the Regional Office. In the Narrative report on Lostwood Refuge for May, 1937 are pictures showing run off of water in this coulee. With reference to these pictures one must remember that last winter's snow was light and that run off conditions were very poor.

Biological Importance: The biological significance of this proposed work which received favorable comments from Mr. Salyer, is immediate because it will impound a small pond of water desirable for nesting waterfowl, but is more important in that a large amount of water that would normally run off the refuge is held with in the refuge and diverted into the present dry bed of Elbow Lake. The value of diverting the water into this lake bed is remote because run off from this coulee will probably not be sufficient to fill the lake during this drought period, but it will greatly hasten the availability of this lake for waterfowl when there is more moisture in this region. The gentle sloping shoreline of this medium sized long crooked lake, bordered with remnants of desirable vegetation and surrounded by hills where there are clumps of the dwarfed buckbrush, (Symphorcarpus racemosus) indicate that an ideal environment will result for breeding ducks with the return of water.

Repair of Dam in the Knudson Tract.

Location: On the Knudson tract T. 159 N., R. 91 W., Sec. 21, is one of the best duck areas on the refuge.

Nature of Project: A small dam impounding the water run off from seepage springs has caused an ideal marsh condition dominated by hardstem bullrush (Scirpus acutus). In the open water and among the rushes are the aquatics, sago pondweed (Potamogeton pectinatus) muskgrass (Chara sp.) and bladderwort (Utricularia vulgaris). Since there is a seepage of water around this dam, a clay fill is necessary to prevent further seepage. While this work is being done it might be advantageous to raise the dam 1 to 1½ feet so that if the springs become more active larger marsh and open water area will result.

Biological Importance: The value of this work for waterfowl is portrayed in the nature of the work. If the water level is raised much over 1½ feet, the existance of the present marsh growth would be endangered.

Island Construction

Location: Water recession due to drought has shown natural conditions which could advantageously be altered and made into permanent islands on the 3 large brackish lakes, Thompson, Upper Lostwood and Lower Lostwood Lakes in the Northern, Central, and Southern part of the refuge.

Nature of Project: Water recession in Upper Lostwood and Thompson Lakes has revealed 6 low water islands of boulders, gravel and sand which (as previously state by Low) could be improved by building up to the height of normal waterlevel (about 2 to 3 feet). The rugged nature of boulders and gravel which would be used in the construction of the outer portion of the island would insure its permanent location in spight of wave action. It would seem advisable to concentrate on the outer portion in building up these islands.

During a recent field trip and conferende with our engineer and camp superintendent, Mr. L. Lansing, and Mr. Low, Lansing explained that it was perfectly feasable from an engineering and construction standpoint to build these islands. The firm lake bottom and shallow water between the main land and the island can not be considered much of a barrier in doing this work since it would be an easy matter to build an earth fill road to the island and deposit a large amount of this earth road upon the island as the earth moving equipment is taken off.

Of the six suitable sites for this kind of island development, four of the more desirable have been chosen. In Thompson Lake chosen sites are located on the north and south end, and in Upper Lostwood Lake chosen sites are the two larger islands seen on the west side.

Conditions at the Lower Lostwood Lake are different. With reference to this lake Low adequately states, "Lower Lostwood Lake has not revealed any low-water 'islands'. By ditching, however, there is a possibility of creating a very large island at the north end of the slough. This has been indicated by the accompanying map." (Map was sent to the Regional Office by Low with letter of explanation dated December 11, 1937) "The map is far from accurate. It shows the three sloughs as being widely separated. Such is not the case. Each is separated from the other by a narrow sandy isthmus."

Biological Importance: When the water approaches normal levels again there will be no islands if this construction work is forsaken. Since the importance of islands for waterfowl is well known, nothing more need be added on this subject.

The nature of the donstruction of these islands will make them desirable for a greater variety of birds than islands that are built on other refuges. The brackish nature of the coarse stoney lake bottom material that will be used along the outer edges of the islands will tend to discourage plant growth and thus will result in desirable nesting sites particularly for some of the shore birds, such as avocets which do not choose vegetative cover sites for nesting. On the more contral part of the islands where a soil fill suitable for plant life can be placed, there will be a suitable environment for waterfowl desiring plant cover.

Perhaps a still more favorable impression of this proposed island construction can be shown by following a biological trend of change from the present to a possible future condition. At present these islands appear to be built in brakish water that might be classed as an aquatic desert. But this is far from being true. To be sure there is no fish or macroscopic plant life, but the abundance of aquatic insect life, particularly Corixas spp. is surprising. A swim in Thompson Lake was made rather unpleasant by Corixas which had a tendency to bite causing a feeling of being pin pricked. During the fall the very great amount of exoskeletons of aquatic insects washed up on the east shore of Lower Lostwood Lake was surprising. These water insects serve as food particularly for shorebirds, also for ducks, as well as other waterfowl. In the future when the alkali condition of these waters is diluted, aquatic plant and fish life that are tolerant to less brakish conditions can be introduced and these large water tracts will become better suited to ducks and other fowl such as grebes, cormorants, pelicans, and terns, which prefer and in some cases require islands for nesting places.

Conclusion

Although from an engineering or constructive standpoint these proposed jobs may not seem to be very impressive, from a biological standpoint the results of this work will compare very favorable with work of the same type done on other refuges.

Another point of particular interest bearing on this work is that the improvement work asked for contributes to the environmental desirability of the refuge during a drought period and more so during a time of rainfall.

Upper Souris Refuge

Fish Stockings A proposed and future project worthy of consideration on the Upper Souris Refuge is the stocking of Lake Darling and lower pondsites with fish. The pondsite above dam # 41 should not be stocked until it is filled with water.

Oxygen Supply: It appears that there is sufficient depth in these bodies of water to insure a sufficient oxygen content over and above that necessary for decay and respiratory processes of aquatic life so that fish will not die from lack of oxygen during the winter freeze over. (These conclusions are based on lake studies made by the writer with the Wisconsin Land Inventory 1930-1935 and on the more intensive and precise studies of professors E. A. Birge, C. Juday and associates of the Limnological Laboratory of the Wisconsin Geological and Natural History Survey.)

Food Supply: Field observations of 1935, 1936 and 1937, by the personel employed on this refuge and by the writer certainly shows that there is an ample supply of forage fish, or minnows necessary as food for game fish. Fresh water shrimp and particularly large numbers of aquatic insects have also been observed in these waters. Of the marsh and aquatic plants that have a direct and indirect bearing on fish life, beds of leafy pondweed (Potamogeton foliosus) and swamp smartweed (Polygonum muhlenbergii) are worthy of special note. Other pondweeds in this area are sago pondweed (Potamogeton pectinatus) and redhead grass (P. richidsonii)

Observation on Age and Fish Growth: It is to be regretted that very little work has been done on field studies dealing with the growth of fish in reference to there age. Attempts will be made to do some of this work in the immediate future.

Recently a 16 pound northern pike (Esox lucius) was caught by locals just north of the refuge. Scale studies show that this fish to be 7 years old. Upon further checking on old notes it appears that this is an excellent growth for this fish and tends to indicate that food conditions for game fish are very good. It is also interesting to note that this fish must have devoured 260 to 270 pounds of food, mainly minnows, in order to reach the weight of 16 pounds. An application of the above information on fish environment implies the planting of fish in these waters. Such a program as previously shown and explained by superior officials fits in to the proposed purposes of a refuge sine it will tend to produce an out flow of wildlife that is of direct value to sportsmen and conservationists.

HIGH DAMS

Dam No	Cu. yds. fill	Storage in acre feet
1	22400	270
2	11000	53
3	43500	187
4	7000	34

LOW DAMS

		Surface Area
5	925	1.6 acre
6	700	1.8
7	460	.7
8	1200	1.5
9	1495	10.2
10	650	1.7

1935

Area of large numbers of dead birds

Area of few dead birds

1936

Region of large numbers of dead birds

Region of few dead birds

R. 89 W
R. 88 W
R 88 W.
R. 87 W.
T 164 N.
T 163 N.
T 163 N
T 162 N
T 162 N
T 161 N.
T 161 N
T. 160 N.

PROPOSED DAM CONSTRUCTION

UPPER DES LACS

KENMARE, N. DAK.

DRAWN BY G.F. TISE

Des Lacs Waterfowl Refuge
Kenmare, North Dakota
January 17, 1938

NARRATIVE REPORT ON ACTIVITIES
December, 1937

It hardly seems necessary to write a narrative report because most of the work has been of a routine nature dealing with preparing my share of the Aleutian Island report.

Aleutian Island Report

While I was on the Aleutian Island Expedition, it was decided that different members of our party would work over some particular phase of our field work. My share of the report was to deal with the vegetation. At a later date Mr. O. J. Murie, who was chief of our party would correlate his conslusion on bird notes, etc., with the contributions of the different members of our party. Since all problems of our field study were discussed in detail before we parted, we all have a definite understanding of what our task is.

Birds: Notes on observation of birds, and collection notes on bird skins, skeleton, etc. have been checked over and sent to Murie.

Plants: The checking and working over the plant collection proved to be a tedious job. Doctor V. B. Scheffer, a member of our party has sent his plant collection to me. Murie will probably add his findings to the notes when the plant report is sent to him. All members of our party have contributed all they know on the nomenclature of these plants. While our boat, the Brown Bear stopped over in Juneau, Alaska, we had the privilege of meeting Mr. J. P. Anderson, a botanist and florist who had been collecting Alaskan plants for a number of years and was contemplating writing a manual on the plants of Alaska. He worked with Doctor Eric Hulten, a Swedish botonist of repute, who has recently completed his field studies on Aleutian plants and their distribution: in fact, a paper by Hulten on this subject is at the printers now. Anderson had a chance to glance over a large number of these plants, and he named quite a few of them.

During the month of December an attempt has been made to arrange these plants systematically and name as many as possible. I regret to admit that I was able to name only a few of the plants and would like to have these names verified, and the other plants named. Accordingly the collection has been sent to the Bureau of Biological Survey.

Previously my instructions were to start a mapping project on the primary refuges of North Dakota and Medicine Lake of Montana, and then to work on the Aleutian data during the winter. On December 4th Murie asked for the results of the plant studies, and I found myself awkwardly unprepared. It is hope that the identification of these plants will be hastened. While waiting for the identification of these plants, an attempt will be made to figure on the distribution of these plants by referring to the collection numbers.

Fell

Vegetative Cover Type Maps: A better understanding of the vegetation particularly from the standpoint of its use can be had by knowing more about the plant cover. Accordingly two sample plots having vegetative floral types typical of the Aleutian Islands were mapped on Kanaga and Igitkin Islands. Mr. J. Tise, assistant to technician, made excellent copies of the original field maps for the Aleutian Island report. Symbols for floral types were in accord with the plan of mapping outlined in "Vegetative Classification for Cover Mapping", that was used on the waterfowl refuges. These plant cover types will be described in detail and further amplified by pictures of the vegetation taken by members of our party during the expedition. Scheffer has recently sent a remarkable collection of pictures of Aleutian plants some that have been identified by Hulten. These pictures will be of aid in identifying some of these plant collections.

Water Analysis: The thorough and precise technique that Tise employs on a job made it possible to depend on his results in titrating water samples from the Aleutian islands and from local refuges. These tests were made to determine the fixed or bound CO_2. We are grateful to Doctor J. S. Bordner of the Wisconsin Land Economic Survey for equipment and solutions for making these tests. The possible significance of this water analysis will be explained in a later reports.

North Dakota Refuges: Results of conferences and field trips with refuge managers have been discussed in previous narrative reports.

I regret that I have failed to have a complete and thorough understanding of the different phases of biological development with the refuge manager at the Des Lacs Refuge. This relation is a direct contrast to the frank and complete cooperation that has been experienced with all other refuge managers. If time were spent to pry into the nature of the development work and in going through the usual awkward procedure of working up a cooperative project, little or no time would be left to work on the Aleutian material, consequently, the Des Lacs Refuge is being left alone and I am attempting to finish my contribution to the Aleutian Report with the view in mind of having a definite understanding on the spring and summer work program on biological development irrespective of relations.

NARRATIVE REPORT ON ACTIVITIES

for

November 1937

November's work program dwelt mainly with getting a mapping program started at Arrowwood Refuge and checking on the mapping at the Des Lacs and Upper Souris Refuges. While these mapping projects were being carried on, conferences and field trips with refuge managers served as a means of getting a definite understanding of biological conditions on the refuges. Work programs on biological development were drawn up where necessary, and if refuge managers and camp superintendents had already drawn up a work program, amendments were added if needed. Conclusions explained in this report are the result of collective observation and thought by myself and refuge managers.

Water samples are being gathered from the refuges for the purpose of making a fixed or bound CO_2 test. Juday's limnological work in Wisconsin tends to indicate a relation between the carbonate concentration and other salts that have a distinct bearing on water biological environment. I have managed to secure solutions from the Wisconsin Land Inventory with whom I used to work, for making tests on water collected on the Aleutian Islands and have enough for making tests of water from some of the refuges in this vicinity.

Upper Souris Refuge

Winter Work Program: A winter work program has already been drawn up for the Upper Souris Refuge as was explained in the last months report. As per instruction noted from Mr. Sayler's letter of September 30, 1937, and Mr. Maurek's letter of October 2, 1937, this program was submitted to the regional office for further amendments and approval. To date nothing has been heard. Further delay will handicap game improvement work on this refuge.

Conferences with Mr. Dougal, refuge manager, and Mr. Racke, camp superintendent, showed that the construction of fish shelters could be put in effect since Mr. Racke already had a project approved on this type of work. Other projects dealing with the construction of spawning rafts for minnows, wave breakers, rail fences, improvement for brush islands, and brush and lean-to shelters for upland game will have to wait further approval from the regional and Washington office.

Lower Souris Refuge

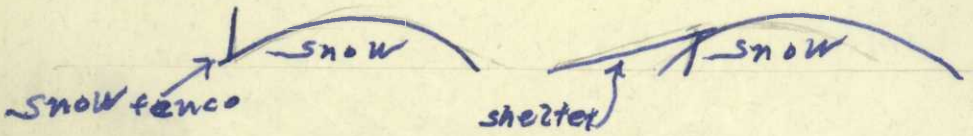
The report on the Lower Souris Refuge was given in the last months narrative report.

Arrowwood Refuge

Cover Type Mapping: A cover type mapping program that was started with the Assistant to Technician, Mr. Rognelie, was shown and explained in detail to Mr. Craven, refuge manager, so that he can check on the field maps.

On this refuge we were momentarily confused when mapping a marsh type ov vegetation not having any dominant plant type of species. Finally we ended up by choosing the plant types that seemed to be prominant and also of significance particularly in the immediate future. The density of the plant specie or association was shown and further description of the mixed marsh growth was explained in the notes that accompany the field map.

Lean-to Shelters: Mr. Craven has followed instructions issued by Mr. Salyer when he visited the refuge in 1936. However, in carrying out these instructions there are certain adaptations to environment that are worthy of note.



Snow readily filled in the more exposed lean-to shelters three to four feet high as shown in the above diagram. Accordingly some of the shelters were made higher and the upright supports were surrounded with a shock of corn. The result was that the snow drift was further forward . Such a practice is not necessary at Lower Souris, Upper Souris, and Des Lacs Refuges because there are large coulees and brush and tree clumps in and near which shelters can be located where the bulk of the snow will drop before it reaches the shelter.

The objection that the opening in the back of the shelters will allow wind and snow to come in can be corrected by extending part of the top further out so that the opening can be made along the sides of this extended part of the roof.

Food and Cover Conditions for Upland Game Birds: If the winter is mild and there is not much snow, upland game birds will have little trouble during the winter since there will be an ample amount of weed seeds, grain, and grit in the form of gravel. But if there is the usual snow, it may be necessary to put out a mixture of seeds and gravel in those parts of the refuge lacking berry bearing plants such as rose and buckbrush. Seeds mixed with gravel will tend to prevent the gravel from freezing solid.

Coulee Dams: It was a real privilege to see coulee dams which will impound small shallow ponds of water that are so desirable for ducks. This project will greatly increase the desirablity and capacity of this refuge for nesting waterfowl. The small amount of water impounded by these dams will have little or no effect on the larger marsh and pondsites. Though these small ponds of water are liable to dry up in the late summer, they will have served their purpose, and broods of ducks can easily reach the adjoining larger bodies of water. It is hoped that the construction of couless dams will be allowed on the Upper Souris and Des Lacs Refuges.

Medicine Lake Refuge

Cover Type Mapping: No mapping project was started at the Medicine Lake Refuge because winter was setting in.

Large Nesting Islands: The large nesting islands being constructed by the C.C.C. are built in a manner that makes them desirable for waterfowl, but they are too close together. Though a more desirable environment for waterfowl would result if the construction of islands were continued in this manner, it seems advisable to place the islands farther apart because of the expense involved. Plans have already been outlined for the gravelling and placing of boulders and rocks on these islands as has been done at the other refuges.

Upland Game Bird Conditions: Berry bearing plants which usually hold their fruit through the winter did not bear fruit because of the drouth. The weed growth of Russian thistle, bindweed, and the pigweeds will furnish seed for feed if they are not covered over with too much snow. After a heavy snow fall, it may be necessary to put out some hopper feeders with a mixture of seed and gravel in those places where there is a concentration of birds.

In the sandhill unit of this refuge there is a lack of food. However, it is possible that sharptail grouse may bud to some extent on chokecherry which has already been observed on the Upper Souris Refuge. In view of these conditions it seems advisable to place hopper feeders in lean-to shelters in this sandhill area. Mr. Kreager, refuge manager, has already placed some of the hoppers in the lean-to shelters.

Des Lacs and Lostwood Refuges

No definite management plan of biological development has been discussed and worked over for the Des Lacs and Lostwood refuges with Mr. Low, refuge manager. However, we will probably get together in the immediate future.

S. F.

Kubichek

Please note the underlined work program held up. Coulee dam projects turned down

(Pages 1 & 3) Stevens

NARRATIVE REPORT ON ACTIVITIES
for
November 1937

November's work program dwelt mainly with getting a mapping program started at Arrowwood Refuge and checking on the mapping at the Des Lacs and Upper Souris Refuges. While these mapping projects were being carried on, conferences and field trips with refuge managers served as a means of getting a definite understanding of biological conditions on the refuges. Work programs on biological development were drawn up where necessary, and if refuge managers and camp superintendents had already drawn up a work program, amendments were added if needed. Conclusions explained in this report are the result of collective observation and thought by myself and refuge managers.

Water samples are being gathered from the refuges for the purpose of making a fixed or bound CO_2 test. Juday's limnological work in Wisconsin tends to indicate a relation between the carbonate concentration and other salts that have a distinct bearing on water biological environment. I have managed to secure solutions from the Wisconsin Land Inventory with whom I used to work, for making tests on water collected on the Aleutian Islands and have enough for making tests of water from some of the refuges in this vicinity.

Upper Souris Refuge

Winter Work Program: A winter work program has already been drawn up for the Upper Souris Refuge as was explained in the last months report. As per instruction noted from Mr. Sayler's letter of September 30, 1937, and Mr. Maurek's letter of October 2, 1937, this program was submitted to the regional office for further amendments and approval. To date nothing has been heard. Further delay will handicap game improvement work on this refuge.

Conferences with Mr. Dougal, refuge manager, and Mr. Racke, camp superintendent, showed that the construction of fish shelters could be put in effect since Mr. Racke already had a project approved on this type of work. Other projects dealing with the construction of spawning rafts for minnows, wave breakers, rail fences, improvement for brush islands, and brush and lean-to shelters for upland game will have to wait further approval from the regional and Washington office.

Lower Souris Refuge

The report on the Lower Souris Refuge was given in the last months narrative report.

Arrowwood Refuge

Cover Type Mapping: A cover type mapping program that was started with the Assistant to technician, Mr. Rognelie, was shown and explained in detail to Mr. Craven, refuge manager, so that he can check on the field maps.

On this refuge we were momentarily confused when mapping a marsh type ov vegetation not having any dominant plant type of species. Finally we ended up by choosing the plant types that seemed to be prominant and also of significance particularly in the immediate future. The density of the plant specie or association was shown and further description of the mixed marsh growth was explained in the notes that accompany the field map.

Lean-to Shelters: Mr. Craven has followed instructions issued by Mr. Salyer when he visited the refuge in 1936. However, in carrying out these instructions there are certain adaptations to environment that are worthy of note.

Snow readily filled in the more exposed lean-to shelters three to four feet high as shown in the above diagram. Accordingly some of the shelters were made higher and the upright supports were surrounded with a shock of corn. The result was that the snow drift was further forward. Such a practice is not necessary at Lower Souris, Upper Souris, and Des Lacs Refuges because there are large coulees and brush and tree clumps in and near which shelters can be located where the bulk of the snow will drop before it reaches the shelter.

The objection that the opening in the back of the shelters will allow wind and snow to come in can be corrected by extending part of the top further out so that the opening can be made along the sides of this extended part of the roof.

Food and Cover Conditions for Upland Game Birds: If the winter is mild and there is not much snow, upland game birds will have little trouble during the winter since there will be an ample amount of weed seeds, grain, and grit in the form of gravel. But if there is the usual snow, it may be necessary to put out a mixture of seeds and gravel in those parts of the refuge lacking berry bearing plants such as rose and buckbrush. Seeds mixed with gravel will tend to prevent the gravel from freezing solid.

Coulee Dams: It was a real privilege to see coulee dams which will impound small shallow ponds of water that are so desirable for ducks. This project will greatly increase the desirablity and the capacity of this refuge for nesting waterfowl. The small amount of water impounded by these dams will have little or no effect on the larger marsh and pondsites. Though these small ponds of water are liable to dry up in the late summer, they will have served their purpose and broods of ducks can easily reach the adjoining larger bodies of water. It is hoped that the construction of coulees dams will be allowed on the Upper Souris and Des Lacs refuges.

Coulee dam projects turned down on both refuges this past summer

Medicine Lake Refuge

Cover Type Mapping: No mapping project was started at the Medicine Lake Refuge because winter was setting in.

Large Nesting Islands: The large nesting islands being constructed by the C.C.C. are built in a manner that makes them desirable for waterfowl, but they are too close together. Though a more desirable environment for waterfowl would result if the construction of islands were continued in this manner, it seems advisable to place the islands farther apart because of the expense involved. Plans have already been outlined for the gravelling and placing of boulders and rocks on these islands as has been done at the other refuges.

Upland Game Bird Conditions: Berry bearing plants which usually hold their fruit through the winter did not bear fruit because of the drouth. The weed growth of Russian thistle, bindweed, and the pigweeds will furnish seed for food if they are not covered over with too much snow. After a heavy snow fall, it may be necessary to put out some hopper feeders with a mixture of seed and gravel in those places where there is a concentration of birds.

In the sandhill unit of this refuge there is a lack of food. However, it is possible that sharp-tail grouse may bud to some extent on chokecherry which has already been observed on the Upper Souris Refuge. In view of these conditions it seems advisable to place hopper feeders in lean-to shelters in this sandhill area. Mr. Kreager, refuge manager, has already placed some of the hoppers in the lean-to shelters.

Des Lacs and Lostwood Refuges

No definite management plan of biological development has been discussed and worked over for the Des Lacs and Lostwood refuges with Mr. Low, refuge manager. However, we will probably get together in the immediate future.

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Mr. Salyer
Mr. Elmer
Mr. Ball

81

NARRATIVE REPORT ON ACTIVITIES
FOR
OCTOBER 1937

John H. Steenis
John H. Steenis
Assistant Refuge Manager

Mr. Berry
Mr. Shaw
Mr. Bell

MONTHLY REPORT ON ACTIVITIES
FOR
OCTOBER 1937

John H. Steen
Assistant Refuge Manager

NARRATIVE REPORT ON ACTIVITIES
FOR
OCTOBER 1937

This narrative report will deal mainly with the progress of work programs having to do with Biological development and proposed future work programs.

MAPPING PROJECTS

A mapping project already started at Lower Souris Refuge by Mr. Henry, Refuge Manager, Mr. Jenson, student biologist, and now carried on by Mr. Hammond, biological aid, was studied with the view in mind of effecting and standardizing a system of vegetative cover map types based upon the types already worked out. Most of the area mapped on the Lower Souris Refuge was done in marsh areas. The marsh and aquatic types previously determined by the Section of Food Habits pointed the way for further choice of cover types for swamp and upland cover.

The choice of cover types outlined below was determined collectively by Mr. Henry, Mr. Hammond, and myself.

Herbs:
H_1 Weeds--mixture or one species dominant.
H_2 Sweet clover and Alfalfa.

Grasses:
G_1 Long Grasses--mainly mesophytic grass--mostly tall enough for hay.
G_2 Short Grasses--mainly zerophytic grass--like Buffalo grass.

Brush (Upland):
B_1 Dwarfted Brush (Buck-brush, Silverberry, etc. dominant).
B_2 Dwarfed Brush (Rose prominent)
B_3 High Brush (Choke-cherry, Juneberry, Plum, Thornapple, etc.)
B_4 High Brush (High Brush as in B_3 with Rose prominent).

Brush (Damp to Marsh Enviroment):
S_1 Willow Brush.
S_2 Fruit bearing brush, usually associated with damp enviroment, stream banks, Swamp or Marsh Border, or damp forest or tree groves.

Trees:
F_1 Mixed hardwoods
F_2 Populus spp.

Agricultural Crops:

A_1 Grain
A_2 Cultivated crops.

Marsh Trees:
T_1 Willow

This choice of types was based mainly on wild life use

and were quite broad. For a more detailed study of the vegetation, field notes are being made describing in detail the nature of cover types as to dominant and subdominant plants for the forty, quarter, or section as circumstances demand.

The marsh types used in North Dakota are:

Marsh:
M_1 Round Stem Bulrush
M_2 Three Square Bulrush
M_3 Leafy Bulrush
M_4 Smart weed
M_6 Wild Millet
M_7 Duck Potato
M_8 Other broad leafed marsh plants
M_{10} Spiked Rush
M_{16} Bur-reed
M_{17} Sedge
M_{18} Cat-tail
M_{19} Reed canes
M_{24} Marsh meadow

At the Upper Souris Refuge, Kreusr, Assistant to technician, was started on a vegetative cover mapping program. Kreuser previously has had experience with a Geological survey party and has studied plants of value for wild life. This experience has made it possible for him to do cover type mapping with very little preliminary field training.

At the Des Lacs Refuge, Tiese, an engineer of contour mapping experience, had to learn plants and distinguish cover type plant associations. After about ten days of intensive field training on plants and vegetative cover types, Tiese demonstrated that he was qualified to carry on cover type mapping.

The difficult and most precise mapping of aquatic plant life is not being done on any of these refuges because this water vegetation is in part decomposed. Such mapping cannot be successfully carried on until next July.

A cover type mapping project is being started at the Arrowwood Refuge and if the weather permits will be started at the Medicine Lake Refuge.

WINTER WORK PROGRAM

While this cover type mapping program is being conducted, plans are also being drawn up for winter work dealing with biological development. No projects are being drawn up for Lower Souris Refuge since Mr. Henry has this refuge well in hand.

Since the following winter work program on the biological development of the Upper Souris Refuge was a large part of the work done this month and has been sent to the Regional Office for approval, it is included in the narrative report. If this plan of development goes through, past working relations indicate that excellent cooperation can be expected from theC.C.C.

Tiese mapping at Des Lacs Refuge

A weasel makes inquiry about cover mapping.

Conference and field trips with Mr. Kubechek, Mr. Dougal, and other Upper Souris Refuge personnel, and past field work on this refuge has furnished the background for this proposed work program.

Pond Site Below Resevoir Dam

Bulrush Planting: Rootstocks of hardstem bulrush(Scirpus acutus) are being dug at the Des Lacs Refuge. If the present spell of warm weather continues, it would be advisable to plant clumps of these rootstocks with the soil left on in these pondsites just below the water level at intervals of 3 to 4 feet. Bulrushes should be planted on marginal bare mud flats not having other marsh plants, such as bulrushes, spiked rush, swamp smartweed, and cord grass. Though field observation showed that fall planting does not produce as good growth as spring planting, it is advisable to do some planting this fall because the water level is 18 inches or more below the usual level and thus makes it possible to plant the rootstocks just below water level rather than 1½ to 2 feet below water level as should be done next spring.

Considerable planting was done last spring and fall by pushing rootstocks in the mud with a rubber booted foot and often there was difficulty in getting the booted foot out of the mud. Mr. Henry, Refuge Manager at Lower Souris Refuge, found that if these rootstocks clumps were pushed down with a stick or some similar object which is then slowly pulled out, that clumps of bulrushes can be planted without having that difficulty.

The importance of planting bulrushes in pondsites along mud flats needs further emphasis. Though the hardstem bulrush is known to be an excellent cover plant and fair food plant, the main purpose of this marginal planting is to prevent wave action from roiling the water. Aquatic plants do not thrive in roiled waters. The existing nucleus of leafy pondweed (Potamogeton foliosus), sago pondweed (Potamogeton pectinatus), and red head grass (Potamogeton Richardsonii) will spread rapidly if these waters remain clear.

Small Brush Islands: During the winter of 1935-36 the clearing of the lower pondsites was collaborated with the building of small log cribbing brush islands and other habitat improvements of brush and logs. These small brush islands have never been finished. In their present state they are useless and in fact, stick up like sore thumbs. In the "Preliminary Instructions to Wildlife Technichians" by Mr. Kubechek in 1935 and in Mr. Salyer's conference of 1935-36, requests were made to construct and complete these islands.

Originally these islands were constructed about 1½ feet above water level to allow for settling. Some of these islands were built too low and others too high, but most of them appear to be the correct height. At present these lower pondsites are 18 inches or more below the required water level. After freeze up it will be

possible to build up islands that are too low and take off the tops of islands that are too high. Mr. Dougal suggested that the log cribbing of the brush islands should be water level height. The islands should then be capped with straw and soil. This type of island construction sounds temporary, but if these islands are properly planted with root-stocks of hard stem bulrush and cordgrass, the thick underground stem ofthe bulrush will tend to grow a riprap around the waters edge and the extensive rizomb and root growth of cord grass (Spartina Michauxiana) will tend to hold and build up the soil as the underlying straw decays.

The eventual result will be many small island nobs of marsh growth that furnish ideal nesting sites for such diving birds as canvas-backs, redheads, and scaups or bluebills.

LAKE DARLING

Fish Shelters: The cutting and clearing of the Souris River banks in the Lake Darling area should be collaborated with habitat improvements for fish life as was done last year. The fluctuating water levels of this resevoir lake makes the building of small brush islands and spawning rafts for minnows useless. Existing conditions should determine the type of fish shelters to be built. Of the various kinds of fish shelters, the knocked down tree type is the most desirable. Other suitable kinds of fish shelters are the lean-to (for steep banks), the ridge pole, flat brush, and Iowa types. These fish shelters should be placed 70 feet or more apart; 100 feet would be better. Because of the fluctuating water levels, fish shelters should be anchored in a sloping manner along the banks so that they will be of value to water life inspite of varied water levels. The method used in building fish shelters last winter is satisfactory and should be continued.

PONDSITE ABOVE DAM UNIT 41

Large Dirt Island Improvement: The large dirt islands that were made by ditching and throwing up earth above the water level should be improved by gravelling the ends in a class C style of riprapping. These gravel patches should be at least 70 or more feet in length and should extend below the water level. On some of the longer islands it would be advisable to have a gravel patch in the center. This gravelling of islands has already been started and should be continued.

In the meeting with Mr. Salyer in 1936 he explained that several of the larger islands can be improved for a greater variety of waterfowl, particularly shorebirds, by placing a pile of loosely arranged rocks and boulders on them. Some of these rocks should be two man rocks and there should be ample interspaces and depressions within the pile. Marginal to and strewn about this rock pile should be other rocks and boulders that are alone and in groups of twos and threes. This pile and scattered boulder improvement work should appear natural, that is, similar to scattered rock and boulder concentration that results from glacier moranic depodition.

Fish Shelters: The building of fish shelters should be

continued and as in Lake Darling natural conditions will determine the type of fish shelter to be built. The top of these shelters should be at least 2 feet below water level; 3 feet would be better.

Fish shelters should be built in groups of threes. Each shelter of the group should be about 70 feet apart and each group should be 100 yards apart. It is not advisable to always follow this set rule in the placing of fish shelters. For example, there will be times when considerable work will be saved by cutting down a large tree and securely anchoring it to stump ends along the bank.

Dense clumps of willows should be left if they are covered with water when the pondsite is filled. These bushy clumps, like fish shelters, will harbor food and give shelter for a concentration of minnows and other fish which will in turn be directly or indirectly used as food for game fish and other forms of life.

Log Cribbing Brush Nesting Islands: In the small part left to be cleared a few more of the log cribbing type of brush islands should be constructed to a height of about one foot above water level so that it will be of proper height after it settles.

Spawning Rafts: The construction of spawning rafts has been discouraged and neglected. A spawning raft is built by nailing heavy slabs of wood or boards on logs about 6 inches or more in diameter. (See page 73 in Standard Construction Details). The spawning rafts should be securely anchored to the ground in those places where there will be a depth of about 20 inches of water above it. If boards are not available, a spawning raft can be made by using a compact, dense, flat layer of brush.

Old lumber can be used to build star shaped devices for spawning minnows. However, these structures are not as good as the spawning rafts. It is a good inside job when the weather is too severe. These structures, like the spawning rafts, should be anchored in shallow water.

Perhaps the building of these minnow spawning structures would be appreciated if their use was explained more in detail. Most small fish belong to the minnow family. Fresh water biologists have found that these fish spawn underneath some object. The importance of doing habitat improvement work for spawning minnows is emphasized in view of the fact that a large-mouth bass , northern pike, wall-eyed pike, etc. will eat 12 to 19 pounds of fish flesh in order to gain one pound of flesh. Furthermore, fish eating birds such as pelicans, herons, cormorants, mergansers, grebes, king fishers and terns stay part of the time on the refuge and feed heavily on small fish life.

Wave Breakers: There are at least 10 sizable fields that will be flooded in this upper pondsite. Since the water level of this pond will fluctuate because it is dependent on stream flow which usually stops during mid summer, exposed mud flats will result which are liable to produce suitable conditions for Western duck sickness(Botulism). This already happened in the lower pondsite

during the past summer. If the water could be kept from becoming roiled, a rapid natural spreading of the aquatic vegetation, mainly the leafy pondweeds, would result and a better balanced biological condition would exist that would not be so suitable to Botulism. The above conclusion is the result of field observations made at the Des Lacs Refuge in the summer of 1936. At that time all the water areas were inflicted with Botulism except the Lower Des Lacs Lake which was surrounded with a heavy marsh growth and covered with pondweeds.

Unfortunately this refuge cannot depend on getting bulrush rootstocks from the Des Lacs Refuge because the present digging ground will be exhausted after this season.

The construction of a series of overlapping wave breakers would greatly decrease a roiled water condition and make it possible for both marsh and aquatic plants to assert themselves in a more rapid manner. These wave breakers should be placed where the water will be 2 feet or more in depth and should protrude about 6 inches out of the water.

Fortunately there already exist in these fields a scattered growth of swamp smartweed (Polygonum Muhlenbergii) which upon being flooded will produce a luxuriant growth both in the water and marginal to it. This plant is well adapted to fluctuating water levels. As a consequence great care should be taken not to place wave breakers where remains of this plant can be found.

UPLAND GAME BIRDS

Brush Piles In Lower Pondsites: When the lower pondsites below the resevoir dam were cleared, the brush that was not used was piled up with the butt ends down. Some of these brush piles served as shelters for game birds, but most of them were useless and served as hide outs for skunks and nesting sites for magpies.

In the field trip and conference with Mr. Kubechek on October 24, 1937, he suggested that about a fourth of these brush piles be repiled so that there would be more space beneath. This would tend to discourage skunks and yet would be better adapted to upland game birds. The other brush piles should be burned.

Lean-to Shelters: The placing of lean-to shelters last year plus continual field observations of last winter made it possible to determine the proper location for future shelters. These shelters should be located marginal to brush clumps in the coulees, in the narrow strip of woodland along the river and by agricultural fields. If there is not sufficient brush cover of thicket near the lean-to shelter, one or two knock down tree types or tepee type of shelter should be built that will serve as hide outs for birds. Such structures should be at least 50 feet distance from the lean-to.

Rail Fence: Mr. Kubechek pointed out that the construction of zigzag rail fences marginal to and from farmer's old wind breaks, isolated clumps of trees and brush, in coulees and on the windward

side of lean-to shelters will furnish more desirable environment for woody plants, furnish bird shelter, and possible nesting sites for ducks such as mallards, and serve as a snow fence for preventing bird shelters from being covered.

Dead Trees: A project has been approved for the cutting out of dead trees in the existing stand of stream bottom woodlands. This project would partially destroy the natural cover that exists and in some places would cause a barren condition that would be practically useless for wild life. However, such a project would be suitable for a park area. In view of these conditions this project should be cancelled.

Care of Upland Game Birds: Mr. Maurek, Acting Regional Director, does not favor feeding upland game birds unless it becomes an absolute necessity. Field observations show that there is an abundance of berry bearing plants such as rose, buck brush, and thornapple that will have available food inspite of heavy xxixxx snow fall. Gravel patches in lean-to shelters and on patrol roads should furnish birds with sufficient grit.

The requested placing of lean-tos 1936

Excerpt from the Upper Souris Narrative Report for December

UAK

PLACING OF LEAN-TO SHELTERS

At first, lean-to shelters were placed in the strips of woodland marginal to the river where birds (pheasants and hungarian partridges) were observed. These structures were critised because they were not in the open and a request was made to place shelters in the open fields and coulees.

by Maucek

During the sub-zero period after the recent snow and blizzard, observations of the shelters built by the WPA showed that most of the lean-to shelters that were originally built in the stream bottom woodland were used by the birds, mainly pheasants. Only two tracks were found in the open fields and nine coulees. Also, these shelters had a tendency to fill with snow. Furthermore, during severe weather a few tracks but no birds were seen in open fields. A few sharp-tailed grouse were observed in one of the coulees marginal to brush. In the strip of woods marginal to the stream there was an abundance of birds tracks in the woods, and marginal to them. These observations are similiar to those made by Mr. Thordarson at the lower part of the Upper Souris refuge, and also to the observations made of shelters at the Tee Lake Refuge.

Deductions and conclusions from these field studies indicate that shelters are more effective in the streambottom woodlands and probably could also be effectively placed in coulees having adequate brush and woodland cover.

Lean-To Shelters

OPENINGS IN SHELTERS.

Field studies made on sizes of openings in the backs and sides of upland bird shelters indicates that small holes are desireable. Birds did not make use of those shelters built in the woods having large openings because there was not sufficient wind protection. These small openings should be sufficiently wide to allow single birds to enter and also high enough to avoid blocking of the entrance by snow.

CHANGES IN CRIB TYPE ISLAND CONSTRUCTION.

Originally small islands were constructed by packing brush into log and pole cribbing structures to heights of about one foot above water level to allow for settling. The tops of these islands are being kept with straw and soil. This packed brush condition would gather sediment and would serve as a wick in furnishing water to the straw and soil cap if water levels drop. This is an important point to consider, since the natural stream flow has been observed to stop in the latter part of July during recent years.

Recently a request has been made to leave the log cribbing more or less hollow to a point just below water level. Several pieces of heavy brush were to be placed in this log cribbing hollow which would result in a desireable fish shelter. At the point just below water level a platform of brush and poles is to be covered with straw and dirt.

In this way a nesting island will also serve as a fish shelter. A dropped water level may result in a parched cap of brush, straw and soil that will not be desireable for plant growth.

The preceding articles the titles of which are marked with asterisks (*) were contributed by Mr. John Stemmis, Assistant Refuge Manager.

Log cribbing island packed with brush. The corner posts are tree stumps that have been cut high. This structure is built 1 foot out of water to allow for settling.

A shelter in tha open field after the first blizzard.

Rail type fence in back of this shelter caught some of the snow.

Upper Souris Refuge

A frame work of crooked logs and poles for teepee type hide out shelter.

Large inner cavity of shelter.

Teepee type of shelter.